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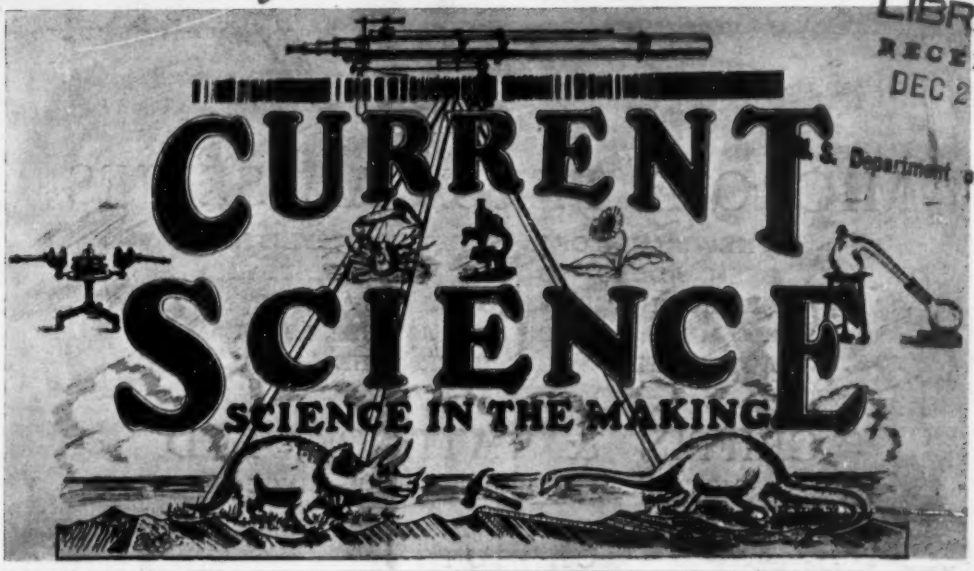

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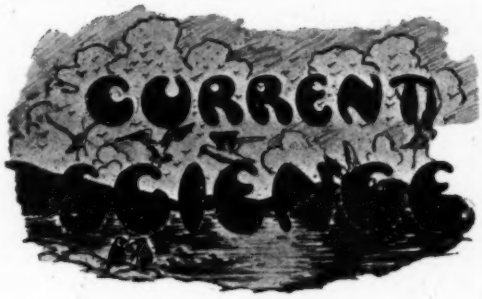

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CONTENTS.

Science and Industry.

IT is not generally realised, even by promoters of Industry, that Science and Industry are no more closely related to each other than Philosophy and Religion. It is indeed true that Science provides the basic material for the development of Industries: it should also be admitted that no industry can prosper unless scientific methods are adopted. On the other hand, Science plays only a small part in the organisation of industry. The scientist is only an humble unit in the machinery that is engaged on the conversion of a cheap raw material into a valuable finished product which the consumer buys. The work of the scientist constitutes the foundation on which the industry is built and which, in consequence, should be safely and securely laid. It does not, all the same, constitute the entire structure. The scientific worker is fitted to lay more foundations and even strengthen the existing basis, but the main structure must be built by others. It would be of much assistance, therefore, to the progress of industry if the significance of the above could be realised by all concerned, so that there need be no delusions regarding the rôle of the scientist in industrial organisations; so that his talent may be more usefully employed in the conduct of fundamental researches leading to new industries or in solving technical difficulties relating to the existing ones rather than be diverted into lines of work for which he is not fitted and wherein he may prove a failure.

The truth of this position is, no doubt, realised by the more progressive industrialists, who collect together the right types of talent and organise them into a homogeneous machinery that constitute the prosperous industry. On the other hand, it is not appreciated by many others, particularly in India where the management content themselves with finding the necessary funds and leaving it to their scientific staff to become also the manufacturers, advertisers and even salesmen! The result is that the scientist is obliged to neglect or put off his legitimate duties. He is not generally fitted by either temperament or training for the different types of operations that he is called on to undertake so that, more often than not, he fails in such ventures. Ultimately the industrial venture also proves a failure and the poor scientist comes in for general censure.

A critical inquiry into the failure of a number of industrial concerns both in India and abroad would reveal that most of them are due to faulty organisation. There is no doubt that certain important factors like the cost of raw materials, efficiency of the processes involved, demands of the market, external competition and the nature and extent of State assistance that largely determine the success or otherwise of any industrial venture, but being given favourable conditions, the prosperity of a concern depends almost exclusively on its efficient organisation. The right type of talent for each particular operation should be found and then fitted into the right place. It is the efficiency of this process that determines the ultimate success of an industrial venture.

It is, perhaps, no exaggeration to state that some of the biggest industrial organisations of the World, like several other great ventures, are essentially the creations of single brains. It is that master-mind which first conceives of the venture, selects the right kind of staff and co-ordinates their work into a homogeneous organisation. Such were Ludwig Mond in England, Alfred Nobel in Sweden, Andrew Carnegie in the United States and Jamsetjee Tata in India. Industrial geniuses of that type are, however, very rare. More often than not the business is managed by small groups of men, sometimes not more than two or three, who understand each other perfectly, who make up for each other's shortcomings and work as a unified body. A management of that type would also possess the requisite vision, the right type of scientific as well as business outlook, necessary skill in the choice of staff and the co-operation of their workers. The success of many of the present-day ventures depends on the efficiency of the combination that constitutes the management.

Now the question arises as to whether the management should consist of business men with the necessary scientific outlook or whether it should also include scientists. A scrutiny of the compositions of the administrative councils of the more progressive industrial concerns in different parts of the world would show that most of them include representatives of the branches of science relating to the industries concerned. Unfortunately, such is not the case in India. More often than not, the management consists of business men—clever, cool-headed in their own ways—but sadly lacking in scientific outlook, with the result that they are out of tune with their works and research staff at whose tender mercies they are often placed for the progress of their venture. The result is that the technical staff determine the policy of their heads and assume more powers and responsibilities than they could do justice to, with the result that the major issues of production and distribution are obscured and the venture proves to be far less successful than it could otherwise be. Sometimes the reverse also happens. The management—non-scientific in outlook—starts with an aggressive hand, with scant courtesy for the opinion of their technical staff, so that the latter is compelled to bow down to their ideas—often unworkable—so that the venture loses in efficiency and ultimately proves a failure. It would be seen from the above, therefore, that the combination of the scientific and the business outlook is essential to the success of any industrial organisation. Where the business men lack the necessary scientific outlook, the proper procedure for them will be to choose scientific men in whom they have some confidence and plan out things in conjunction with them before launching out on their ventures. The representation of scientific interests in the management ensures a certain amount of sympathy and friendliness for the technical staff, as also appreciation of the difficulties involved in the various operations which go to make the industry. No industrial venture will prove successful unless there is proper understanding and close co-operation between the management and the technical staff, and sooner this is realised by those interested in industries, the better it will be for their ventures.

In recent years, several industrial concerns, particularly in India, have proved unsuccessful chiefly because of the over-lapping of the purely scientific and the 'works' staff engaged on the manufacture. It would be of much assistance, therefore, to critically examine the parts played by the two groups of workers in a well-organised factory. The research scientist provides, no doubt, the basic material for the venture. He conducts the necessary preliminary trials—all on small scale—standardises the conditions for the different operations and then passes on the details to the works staff who follow up the idea on commercial scale. It is very rare, however, that the operations lend themselves straightaway to development on bigger scale. More often than not some of the steps which

prove easy in the laboratory turn out to be highly difficult on factory scale or prove too costly to be commercially successful. Some of the difficulties can be overcome by the works staff themselves who can modify the technique to suit their requirements, but cases often arise when the problems will again have to be referred to the scientific staff who will have to devise new methods of managing the operation more efficiently. In this manner there is frequent swing of technical researches between the laboratory and the factory until all the related processes are carried out to perfection. Even then the scientific staff will have to go on with their work, trying cheaper raw materials, alternative methods of manufacture or otherwise go on improving on the process so that the cost of production may be brought down to the lowest possible limit and products of the best quality can be made available at very small cost to the public. It is only then that the process will be in a position to hold the commercial field and face continuous external competition successfully. In India, on the other hand, the purely scientific work of the laboratory is made to overlap with the large-scale operation in the factory, the same staff being employed for both the purposes. In a few places there is some distinction, but it is only in name because the qualifications and the experience of both the groups of workers are of the same order so that the result is, more often than not, highly unsatisfactory.

The above defect is partly due to want of sufficient knowledge of the respective positions of the two groups of operations in an industrial organisation and partly to dearth of the right type of talent, particularly for the management of large-scale operations. There are still several industrialists who are slow to realise that the pure scientist, while being eminently suitable for the laboratory work, is not really qualified for the factory operations. In fact, it will be a waste of talent to divert the research scientist from the laboratory where he can do useful fundamental work to the factory. The managements of many industries are not, however, sufficiently alive to the significance of this weak point in their organisation and make the mistake of trying to save money by employing the same persons to look after both the laboratory research and the commercial operations. The result has rarely ever been satisfactory.

The question naturally arises as to what types of talent are required for the two main groups of technical operations in the industry—scientific research on the one hand and factory production on the other. We will first consider the requisite qualifications of the research scientist, because his work constitutes the basis of the industry. He must naturally be an expert in the related branch of science and possess the necessary imagination to determine how the scientific work should be directed so as to yield the final product at minimum cost. He must have an idea of the prices of the materials he works with, so that he may avoid the use of the more expensive ones if others, equally efficient, can be obtained at lower cost. He must be quick and energetic and be alive to the fact that the rapid solution of the basic principles determines either a successful patent or some quick advantage over other rivals in the field. The industry and skill of the research scientist may often make all the difference between large profits on the one hand and heavy losses on the other. The scientist must also have some idea of the difficulties involved in the translation of his processes into large-scale operations. His methods should also be so planned as to suit, as far as possible, the available equipment in the factory. He need not be an engineer but he must have some idea of the possibilities of the available machinery before advising his factory colleagues to carry out his plan of operations. By so doing, an expert research scientist would eliminate many of the difficulties to be encountered in the factory or, at any rate, so minimise them that the technical process soon becomes an accomplished success. The type of talent required for the purely scientific work in a factory is now being turned out by most Universities and Research Institutions in different parts of the world. It may not be very difficult, therefore, to choose the right type of men for conducting the purely scientific work leading to the organisation of Industries.

The choice of the works staff, on the other hand, is very much more difficult, the chief reason being that the right type of talent is not available. Taking the chemical profession for instance, there are, perhaps, a few thousands in India alone who possess the requisite scientific knowledge but there are very few among them who have had the necessary works experience for conducting operations on commercial scale. The fault is not entirely that of the scientist. It is no

doubt true that many of them do not have either the interest or the inclination for the type of work that a factory demands, but there are also several others who, in spite of their keenness to learn, do not get the opportunity for the right kind of training. Although hundreds of scholars have gone abroad in recent years either at their own expense or that of the State, for training in industries, only a few of them possess the requisite experience for initiating such industries. Most of them would, in fact, appear to have diverted their interests to purely laboratory work partly because the factories were more or less closed to them and partly because there still persists, in every part of the world and particularly in India, much glamour for higher degrees which are much more easily obtained through the laboratory than through the factory. It is this defect in the technical training of the staff, as also want of proper scientific outlook on the part of the management, that have been largely responsible for the non-expansion of several of the existing industries in the country or the failure of many of those that were started during recent years. These defects must be remedied at once for, otherwise, it would be very hard to envisage any useful industrial development in the country.

The question which naturally arises is, how is the condition to be improved? The factories in other countries would naturally close their doors to their would-be rivals. It is very doubtful if even the few factories now working in the country would be prepared to provide training that will lead to the development of similar industries elsewhere. It becomes necessary, therefore, that training in factory operations should be provided in public institutions specially equipped for the purpose. A move in that direction is already in progress in some parts of the country and it is not unlikely that the different technological institutes will soon turn out competent men who could carry out the factory operations relating to different industries.

In modern times, with numerous rival organisations and hard struggle for existence, no industrial venture will be successful without the aid of adequate advertisement and sales agencies. It is not within the purview of this contribution to consider the organisation of these two important lines of activity, but it should be emphasised that they are outside the scope of the scientist, who should not be asked to shoulder them.

Now what is to be the organisation for the development of new industries? It is a vast subject by itself: so we will confine our present remarks to those that relate to the scientist in the factory. It is often suggested that the scientist should come forth with the ideas and methods and get the business man interested in the possibilities of the venture. Some would even go further and suggest that the scientific man should also work out the costs, and demonstrate the working of the factory on a small scale; that he must also study the demands of the market and undertake the disposal of the product. There are probably a few men and women in the world who can manage all the above-mentioned operations successfully, but the majority cannot hope to do justice to more than one each. In the more progressive countries, the idea of a possible industry first originates in the mind of the man with some money and the necessary liberal scientific outlook. He then studies the possibilities of a venture, investigates the trade returns in the particular industry and, if the conditions prove encouraging, he proceeds farther to discuss the possibilities with the scientist, who is an expert in the particular branch and the engineer with the requisite works experience. He then provides funds and facilitates for systematic scientific work either in a place attached to his factory or in a research institution where the operations could be carried out on a small scale. If the preliminary researches prove encouraging, the process is then tried on semi-commercial scale at a place where the required equipment could be had. If this also proves successful, the process is then transferred to the factory where the operation could be carried out on the necessary large scale. The other sections of the organisation will then naturally follow.

It would be seen from the above that although the scientist plays a very important part in the development of industries, there is yet much in the organisation for which other types of talent are required. The future development of industries in the country depends, to no small extent, on the right type of organisation and if this contribution has brought home a few fundamental facts relating to it, then our efforts would not have been in vain.

Organic Manures and Plant Nutrition.

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THE importance of organic manures in agricultural practice has been recognised from the earliest times. In ancient China, as also, to some extent, in Aryan India, the utilisation of different forms of organic waste materials as manures was regarded as an important item of field operation. In the early days, as also in the centuries that followed, it was believed that the plant derives the bulk of its food from pulverised soil and manure together with water. The importance of cultivation was therefore greatly stressed upon and farmers ploughed their lands to bring it to a consistency suitable for direct intake of soil materials by the plant.

The discovery of the fertilising value of nitre and various other mineral salts, as also the increasing evidence to show that the plant derives the bulk of its organic material from the carbon dioxide of the atmosphere, brought about a rapid change in scientific opinion regarding plant nutrition by about the middle of the last century. The later exponents of agricultural science naturally argued that the plant depends on soil only for its supply of water and mineral salts and that the application of bulky organic manures is not only expensive but also quite unnecessary.

Many practical farmers, particularly those of the older generation, did not, however, accept the new theory of plant nutrition. They continued to believe in the efficacy of farmyard manure and would not use the new mineral fertilisers except in small doses and that in combination with organic manures. Their cautiousness did not meet with the sympathy of the younger generation, but subsequent experience has justified the wisdom of such a policy. (1) Mineral fertilisers are not consistent in their action. In favourable seasons they are as good as or even better than organic manures, but in seasons of drought or excessive rainfall they have often proved highly disappointing. (2) Soils continuously treated with the same mineral fertilisers become increasingly acid or alkaline in reaction. The average yields from such areas tend to steadily diminish with time as compared with those of similar soils treated with organic manures. The observations on the permanent manurial plots at Rothamsted, Woburn and elsewhere lend strong support to this statement. (3) In horticultural practice, exclusive use of mineral fertilisers has, generally, proved unsatisfactory. Not only the yield but also the quality of produce is often reported to have suffered as the result of substitution of organic manures by mineral fertilisers. (4) In tropical countries, where soils are naturally deficient in organic matter, the response from exclusive use of mineral fertilisers has not generally been satisfactory. In many places, depressed yields, almost amounting to complete failure of crops, have been reported as the result of heavy applications of minerals in quantities corresponding to those adopted in European countries. (5) In recent years, a number of workers—among whom particular mention should be made of McCarrison and his co-workers at Coonoor and Viswanath and his associates at Coimbatore—have obtained evidence to show that grain and fodder crops raised on mineral fertilisers are comparatively less nutritious or otherwise poorer in quality than those raised on organic manures. The above and related observations have naturally led to the conclusion that organic manures play a more important part in plant nutrition than that of merely conserving moisture in the soil and reducing resistance to the plough as has so far been believed.

A careful analysis of the different possible ways in which organic manures can assist plant nutrition would suggest the following: (1) They may decompose in the soil releasing minute quantities of certain rare minerals which are essential to plant growth but are not provided by any of the known combinations of mineral fertilisers. (2) Some of the organic constituents of the manures themselves or the products of their decomposition in the soil may be directly assimilated by plants with beneficial results. (3) The decomposition of organic manures in soils may be accompanied by profuse evolution of carbon dioxide which would be

assimilated by plants growing thereon, thereby yielding heavier crops than would otherwise be possible.

With reference to the first suggestion, it may be mentioned that most organic manures are essentially of plant origin, so that the prospect of their containing rare minerals not ordinarily present in the soil is rather remote. It is also known that the main mineral requirements of plants are confined to a few well-known groups, while the others are required in such small quantities that most soils in the world may be said to contain sufficient quantities to meet the most exorbitant demands of crops, almost indefinitely.

Direct experimental evidence on this aspect of the problem has not, however, so far been adequate. A number of experiments were therefore carried out by the authors, adding varying quantities of the mineral residues of different organic manures, both by themselves and in combination with other minerals, to acid-washed sand and studying the effect thereof on plant growth. The experiments were carried out with a variety of plants and in different seasons: they were also repeated on a number of soils. As the result of a large number of observations, thus made, it is now possible to state, conclusively, that the commoner types of organic manures do not contain any rare forms of mineral matter that are essential to plant growth. The following observations which relate to one set of experiments would illustrate the above statement:—

Barley raised on	Average dry weight of seedling in mg.
Sand + Complete minerals ..	42·6 ± 1·7
„ + „ + Ash of farmyard manure (by ignition)	36·8 ± 1·2
„ + „ + Mineral residues of farmyard manure (after repeated treatment with hydrogen peroxide) ..	37·5 ± 1·6

As already mentioned, the idea of organic manures or their products of decomposition serving as direct nutrients to plants dates back to the earliest times, though experimental evidence on this aspect of the problem is still inadequate. Particular mention should be made of the work of Wildier who noticed that yeasts do not flourish except in presence of an organic substance, 'Bios', present in beer wort, yeast water and such like media; of Bottomley and Mockeridge, who observed that growth of certain aquatic plants is not possible except in presence of certain substances, the 'Auximones', which are present in organic manures. Later researches, by a number of workers, have not entirely supported the observations of Wildier and Bottomley. The practical significance of such findings, in relation to field practice, is still not clear.

With a view to obtaining some direct evidence on this aspect of the problem, a number of experiments were carried out by the authors with pot-cultured plants. In one set of experiments, a number of organic substances were added to acid-washed sand, both by themselves and in combination with different mineral salts, and the effect thereof on plant growth studied. The experiments were repeated in different seasons and with various species of plants. In another series of trials, aqueous extracts of different organic substances were injected directly into the plant system and the effect thereof on growth and reproduction determined. The injections were also repeated at various stages of plant growth and in different seasons.

The observations on sand-cultured plants have shown that (*a*) even under carefully controlled conditions it is not possible to prevent the action of micro-organisms on the added organic substances, and (*b*) the effect produced by minute quantities of different organic substances, at any rate in the earlier stages of plant life, is indistinguishable from that produced by mineral fertilisers applied together with them. The following table presenting one set of observations would illustrate the position:—

Barley raised on	Average dry weight of seedling in mg.
Sand (1·5 kg.) + Complete minerals ..	27·4 ± 0·8
„ + „ + Dried blood (0·05 g.)	26·4 ± 0·4
„ + „ + Aqueous extract of dried blood (0·05 g.)	27·7 ± 1·0

The injection experiments were first carried out with the sun flower plant (*Helianthus annus* Linn.) and then extended to

other species. The observations showed that aqueous extracts produce no appreciable effect on plant growth. Repetition of the experiments on comparatively mature plants showed, however, that minute quantities of certain substances produce an entirely different, but no less important, effect by increasing the proportion of flower and seed to the whole plant as illustrated by the following results:—

Fluid injected	Percentage (weight) of flower to the whole plant in mg.
Yeast extract	24·4
Farmyard manure extract	24·8
Soil extract	21·7
Distilled water (control)	13·1

The foregoing observations are of considerable practical importance and are now being extended to a large number of agricultural as well as horticultural plants with a view to (*a*) determining the nature of the constituents responsible for the effects observed and the mechanism of their action, and (*b*) devising methods of extending the treatments to field practice. The effects of injecting a number of new substances are also being studied. A number of new methods of direct feeding are also being tried.

There is evidence to show that (1) the carbon dioxide content of the air above a soil treated with organic manure is generally higher than that above a similar area which is either left unmanured or treated with minerals, and (2) when a soil is under vegetation, the carbon dioxide content of the strata of air below the leaves is higher than that above them. These observations combined with the fact that, other conditions being alike, photosynthetic assimilation is proportional to the concentration of carbon dioxide in the air, would suggest that the beneficial effect of organic manures is at least partly due to the enrichment of the atmosphere with that gas. On the other hand, it may be argued that, being a gas, carbon dioxide would get readily disseminated in the atmosphere so that plants raised on mineral fertilisers would receive about the same supply of that gas as those grown on organic manures. Moreover, it should be admitted that artificial enrichment of the atmosphere with carbon dioxide does not always lead to increased crop yield: in fact, the exhaustive researches carried out in Germany and elsewhere would show that many of the crops do not respond favourably to that treatment. As further arguments against the theory, it may be pointed out that (1) no experimental evidence has, so far, been obtained to show that plants can flourish in the absence of atmospheric carbon dioxide while it can be demonstrated by water and sand culture experiments that they can live and grow independent of organic manures, and (2) the quantitative carbon relations between the soil, the plant and the atmosphere have not been defined so that it is not possible to state as to what extent the increased production of carbon dioxide in a soil is due to the oxidation of the organic manure alone.

A critical analysis of the literature on this aspect of the problem would, however, reveal that (*a*) although plants can be raised in the absence of organic matter, yet the growths thus obtained are rarely ever so satisfactory as those on soils, particularly those which are naturally rich in organic matter or receive good dressings of organic manures, and (*b*) the previous workers who sought to increase crop yield by artificially enriching the atmosphere with carbon dioxide did not take the aeration of roots into consideration. There are very few plants in nature which can flourish without adequate root aeration, so that abnormal increase in the concentration of carbon dioxide around the plant would naturally reduce the supply of oxygen to the roots, which would, in consequence, suffer. The availability of carbon dioxide from organic manures would, on the other hand, be largely determined by oxidation changes in the soil which, in turn, are dependent on soil aeration, so that the two essential conditions, namely, adequate supply of oxygen to the roots and increased concentration of carbon dioxide around the leaves would both be satisfied at the same time. It may be concluded, therefore, that the evidence on this aspect of the problem is still incomplete and that further work is needed to define the nature of the relation between the decomposition of organic matter in the soil and photosynthetic assimilation of carbon dioxide.

With a view to throwing some fresh light on the above and related questions, a number of experiments were carried out, adding

organic manures to different soils and studying the attendant transformations, with special reference to the production of carbon dioxide and plant assimilation. The results may be summarised as follows:—(1) In the study of oxidation changes not only the added manure but also the organic matter already present in the soil should be taken into consideration. The latter is not only very much larger in quantity but its decomposition is also vastly more important than that of the former. Various factors such as seasonal changes, cultivation operations, application of different fertilisers and the nature of the vegetation determine the release of plant food from the organic reserves of the soil. (2) Plant growth is possible, at any rate in the early stages, in the absence of atmospheric carbon dioxide. Barley seedlings grown on manured soil show a definite gain in dry weight when air freed from carbon dioxide is drawn over them. No significant difference in weight could be noticed between seedlings grown in ordinary air and those over which CO_2-free air had been drawn, so that it would appear that the bulk of the carbon dioxide assimilated by the plants actually came through decomposition of organic matter in the soil. The following results would illustrate the above:—

Plant growth in the absence of atmospheric carbon dioxide.

Barley grown in	Average dry weight of seedling in mg.
Open air (Control)	$33{\cdot}3 \pm 0{\cdot}8$
Glass chambers (ordinary air drawn through)	$32{\cdot}7 \pm 1{\cdot}6$
Glass chamber (CO_2-free air drawn through)	$33{\cdot}2 \pm 3{\cdot}5$

In view of the evidence to suggest that the oxidation of the organic reserves of the soil is of considerable importance in plant nutrition, a number of experiments were carried out to study the effect of various treatments calculated to assist oxidation changes in the soil. The results showed that not only aeration but also treatments with different oxidising agents are greatly helpful in promoting plant growth. The following observations relating to a poor, gravelly soil containing 0·8 per cent. of organic matter will be of interest:—

Effect of treatment with oxidising agents on plant growth:—

Treatment	Average weight of barley seedling in mg.
Soil alone (Control)	$38{\cdot}2 \pm 4{\cdot}2$
,, + Ferric oxide (3 g.)	$51{\cdot}2 \pm 3{\cdot}1$
,, + Potassium permanganate (0·075g.)	$53{\cdot}6 \pm 1{\cdot}7$
,, + Hydrogen peroxide (1 c.c. of 3 per cent. soln.)	$49{\cdot}8 \pm 3{\cdot}1$

The foregoing observations are of much practical significance. Even the poorest soils of the world contain sufficient reserves of plant nutrients to meet the heaviest demands of crops for several decades, though under ordinary conditions, they are mostly unavailable. Judicious field practice will therefore have to include a system of utilising such reserves of the soil, together with the added manures, to the best advantage of the growing crop. At the same time, profuse decomposition should be avoided as it would result in rapid depletion of the organic reserves without adequate crop return. The oxidation changes should be hastened just at the time when crops require them most and, if possible, retarded at others.

The mechanism of the action of oxidising agents is still obscure. Whether those chemicals react directly with the organic matter forming carbon dioxide and other plant nutrients or merely bring about partial oxidation rendering the materials suitable for microbial action is still to be determined.

The ultimate processes leading to the conversion of organic manures into plant food are not yet fully understood. Particular mention should be made of the large quantities of organic as well as mineral matter stored in microbial cells and the subsequent release of which greatly adds to the fertility of soil. The mechanism of such transformations and the extent to which they are affected by different soil treatments are still obscure.

A further aspect of the problem which requires elucidation is the mechanism of oxidation of organic matter in swamp soils. Although it is now well established that the initial transformations attendant on the application of organic manures, particularly green manures, are of the nature of acid and gas fermentations, yet the subsequent changes leading to the conversion of these products into plant food are not yet fully understood. It is hoped that later researches will throw some light on the above and related problems.

A New Theory of Sun-Spots.

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SUN-SPOTS, though a very long observed phenomenon, still defy satisfactory explanation. As a result of modern astro-physical research, especially with the spectro-heliograph, the facts known about them are many and any new theory attempting to explain the origin and behaviour of sun-spots has to take note of all these facts.

There was a time, years ago, when the very simple idea that sun-spots arose as a result of a hollow in the sun caused by something of the nature of a volcanic eruption, held the ground; but why these spots never appeared at high latitudes in the sun, and why they are largely confined to the equatorial belt of the sun, could not be given a satisfactory explanation. When you add to it the experimental conclusion of a definitely observed periodicity for this solar activity, this simple explanation becomes almost impossible of acceptance. That the dark appearance of these spots is due to the cooler vapours prevailing in this locality and that the cooling is due to the expansion of the hot vapours from the interior that have risen to the surface is quite possible. But then there is the question why if the vapours are right from the interior at a very much higher temperature, they are not actually hotter than the surrounding surface. It may be answered by limiting the origin of sun-spots to within a shallow surface layer of the sun even as terrestrial volcanic phenomenon. Then no very high temperatures different from that of the surface layer are called for. Then the cooling by expansion might become the more predominant factor and the relative darkness of the spots does find an explanation.

The revolutionising discovery of definite rotations round the axis of sun-spots, made with Hale's spectro-heliograph led to the forecast of magnetic fields associated with these spots. This was brilliantly verified by the observation of Zeeman effect in these spots. It was further observed in this study that the spots generally occurred in pairs and that the succeeding spot or spots have, in general, a polarity opposite to that of the leading spot. Thus, any theory put forward now must explain these additional observations as well.

I have been entertaining an idea for the last few years that such polarised phenomenon in the sun can be explained only on the basis of corresponding polarised happenings. An explanation for this peculiar behaviour of sun-spots must be sought in the swarms of planetary or cometary bodies we know to be going round the sun. The assumption is that these fall into the sun giving rise to the spots and that these are bodies having, like planets, a rotation of their own about their axes. Such an assumption seems to explain almost all the observed peculiarities of sun-spots.

(*a*) *Observed Periodicity and Latitude Effect.*—The sun-spot activity has been resolved into a marked eleven-year period and there are indications of the presence of many other periods superposed on this generally accepted period. If we assume the existence of a planetary, cometary or meteoric swarm of this period, the cyclical nature of the sun-spot activity naturally follows. At perihelion passage, some of these bodies which are distributed along a stretch of the orbit may be sucked into the sun, the impact and superficial entry being almost tangential. The observed superposed periods can be explained either as due to these bodies distributed along the orbit or as due to a number of such swarms of different orbits with corresponding periods. That sun-spots occur only about the equatorial belt naturally follows from the above. The orbits must of necessity be distributed at small inclination to the equatorial plane of the sun—hence the comparative absence of high latitude spots, any progressive shift in latitude of the spots with the advance of the period being explained by the corresponding distribution of these bodies in their general orbit which is quite possible.

(*b*) *The Magnetic Peculiarities.*—The magnetic peculiarities, so difficult of explanation on any of the older theories, seem to follow readily from the fundamental assumption made above. The assumption of these planetary bodies naturally involves the further assumption that as planets they have rotations of their own round their own axis. Hence, if such a body were to fall into the sun, the consequences can be imagined

to be as follows. The body, spirally converging on to the sun, hits the surface almost tangentially at a small angle and its penetration into the sun might be only to a small depth. If at all it is massive, its total rise of temperature and loss by vaporisation might be only slight during its rush through the solar atmosphere. Hence its penetration into the sun is certain. The angular velocity of its own rotation about its axes is sure to impart a rotation to the region of the sun round the point of impact and this explains at once the observed axial magnetic field of every sun-spot. The partial vaporisation of the body and outrush of the vapours accompanied by expansion and cooling explains the darkness of the spot, and the spectral changes noticed in spots.

Since the entry of the body into the sun is far from normal, because of its high velocity in its orbit, it is sure to get out, a process in which it may be assisted by the centripetal force due to the rotation of the sun itself. If the intense heat explodes the body, the emergence becomes multiple instead of being single and it accounts for the trailing spots being often multiple instead of being single. It is interesting to note at this stage that the direction of rotation imparted to the solar surface at emergence (from our viewpoint) is opposite to that at entry, even though the body continues to rotate all the time in the same direction. Thus the leading spot being opposed in magnetic polarity to the trailing spot or spots finds a ready explanation on this hypothesis. That the trailing group of spots all of them have the same polarity naturally follows. That in a solar cycle the polarity of leading spots remains unchanged also follows. That spots usually occur in pairs also naturally follows if we assume the incident body to emerge out of the sun, probably to skim the surface again giving rise to another set of spots. Magnetic polarity observed even in localities showing no visible spots also follows, if we realise that some of these incident bodies may be too small to give rise to a spot of appreciable size on the surface of the sun. All the same they give rise to rotations on the solar surface and they are revealed to us as spots by this magnetic effect.

The only remaining aspect calling for an explanation arises from the observation that in succeeding 11-year solar cycles there seems to be a reversal of the magnetic polarity. Our observation and study of sun-spots has not extended through a number of cycles to really justify such generalisations. But inasmuch as the indications are, as stated, we may examine to see how this fits in with our theory. All that one has to make is the further assumption that there are two sets of such planetary bodies going round the sun with a 22-year period with a phase difference of 11 years between them, the individual rotations in the two sets of bodies being in opposite directions.

What these bodies might be, if they are the shattered remnants of comets or planets, if they are the remnants of the arms of a spiral nebulæ whose nucleus is our sun are ideas that suggest themselves for further examination. The long period seems to suggest a cometary orbit of great eccentricity and one wonders if any evidence is available for the axial rotation of the comets. Possibly a cometary theory for the origin of sun-spots is not entirely a new idea. But the writer is not aware of any attempt to explain the magnetic polarities and peculiarities of sun-spots on the assumption of the planetary rotations of such cometary bodies. Hence this new theory of origin and behaviour of sun-spots is put forward for further examination by those engaged in the study of sun-spot phenomena.

Megalithic Work in Assam.

By Dr. J. H. Hutton, C.I.E., D.Sc., *Radnor.*

MEGALITHIC work in Assam is important not only as bearing on the cultural and racial relations between Assam and the adjoining regions, but also as bearing on the whole question of Indian pre-history, and of her cultural and racial connections with the Mediterranean and with Oceania.

Megalithic work in Assam has definite associations with the dead and with their *post mortem* future, and this probably applies also to the Megalithic work throughout India. At the same time such work is, at any rate in Assam, also definitely phallic in certain aspects. These two sides of the culture are interdependent and go together to constitute a fertility cult of the dead.

The souls of the dead are associated with crops and with life in general. The underlying principle is well illustrated by the Karen doctrine that the soul consists of some sort of life-matter emanating from the body so to speak, when the body dies, and entering the crops and so imparting life to them and thence in a recurrent cycle to beasts and men. This idea of life as a finite material substance limited in quantity is common in Assam and may be illustrated by the Lushei conception of it as rising from the body and falling to earth as it were dew. This conception is possibly connected with its association with water and with the remains of a dual fertility cult which conceives of the sky as male and fertilising a female earth. This material conception of the soul or life as a substance has also led to the practice of providing receptacles for it after the death of the body, in the shape of wooden statues or of stones, generally, but not always, in the form of rough stone monuments, sometimes phallic in shape. For some stone menhirs are definitely phallic, while others replace wooden emblems which are phallic. All have definite associations with the fertility value of the individual for whose life-matter they are provided, and generally with the fertilisation thereby of the community for which purpose the phallic shape of the monument may have a sympathetic magical value. (It may here be pointed out that the confusion between the magical value of the phallic emblem and the value of the statue as a receptacle for life-matter is assisted by the fact that both the phallus and the human body when reduced to the minimum of individual design are hardly distinguishable from one another. In any case the practice of erecting statues of the dead to house their life-matter impinges very closely on the magical phallic fertility cult.)

This cult of the life-matter of the dead appears in Assam in varying forms. The well-known monoliths at Dinapur are similar in design to the wooden emblems used at a fertility ceremony by the Angami Nagas, who, however, use simple menhirs differing merely in size to represent the two sexes, or to house their life-matter. On the other hand they are traditionally believed to occupy the site of an ancient market place or meeting place such as is associated with rude stone monoliths at Nartiang in the Jaintia Hills. Here, however, as in the stone monuments of the so-called Kachha Nagas, the female principle is represented by a flat stone dolmen while the male is again an upright menhir. It seems likely that this method of representing the male and female principles has been forced on the Syntengs by the nature of the material used, as they appear to have migrated from the North Cachar Hills, and to have left behind them their typical clan mortuaries with twin waterpools like those still associated in the Khasi and Jaintia Hills with the cult of the dead clan, but having huge phallic urns of sandstone (some still containing remnants of burnt bone) instead of the rectangular cists now used by the Khasis and Syntengs for that purpose in their present country in which only an unworkable gneiss is available for the construction of receptacles for the bones of the dead. Even in the north Cachar Hills sites, however, the use of a menhir and a dolmen (of the type for which Mr. Perry uses the term dissolith) is found by the side of the twin tanks which are still spoken of by the present inhabitants as the "dancing places" of their predecessors. The pre-historic mortuary urns of these sites are in some cases definitely female and in others definitely male in form, suggesting the stone cists still used by the Konyak Nagas which take the form of the sex of the individual whose skull is found within, the life-matter being accommodated immediately after death in a wooden statue pending the removal of the head from the corpse when putrefaction

has facilitated its detortion. Some other allied tribes, however, content themselves with a wooden statue of the dead with horns projecting from the head to receive and protect the skull of the deceased which is conceived as passing downwards from the skull into the figure below. Menhirs and dolmens, however, are found in the villages of these same tribes, though their precise significance has not yet been determined, and much resemble those put up by some Angami Nagas. The latter also erect memorial menhirs which rise from a stone platform which is trapezoid in form, one of the two parallel ends being always shorter than the other while the two sides are of equal length. It seems likely that this platform is so shaped to represent the female principle and the whole construction is analogous to the *lingam* and *sakti* of Hinduism.

It would seem that from being of individual value as a receptacle for life-matter, virtue has attached to the use of great stones in general, particularly in association with the dead or with water. Thus, they have been used in the erection of forts by the Angami Nagas, these forts usually occupying sites under which the founders of the village have been buried. No doubt the life-matter of the deceased gives strength and perpetuity to the building. Megalithic bridges also occur in Assam, and monoliths are very frequently erected on the banks of rivers, particularly at bridge-heads. Megalithic temples and paved approach roads are found associated with fertility cults, and in two such cases at any rate temples of this kind have been associated with human sacrifice or fertility cults; it may be observed that Assam has been a stronghold of Tantric worship.

A number of parallel instances of this belief in a material life-substance as noticed in other parts of India will be found in chapter eleven of the *Report on the Census of India*, 1933. It will be enough here to give a brief reference to the brass images made by Kolis, who collect them till they have an inconvenient number and then consign them to a stream; to the metal image of the dead, placed in miniature dolmens and periodically worshipped, of a tribe in Travancore in Southern India; to the Munda and Oraon practices of putting up stones in honour of the dead, such stones being in the case of Mundas collected in clan or tribal groups. In some cases there seems to be a connection between stone monuments and pot burial, as the Konyak Nagas who use stone cists have an alternative method of burying the head of the deceased in a pot the mouth of which is covered by a second pot or bowl inverted. The use of wooden life-receptacles has a close parallel in the Nicobarese practice of interring the bones in a wooden statue with the skull as a head. The west coast structures in the form of stone chambers with a circular cap, mushroom dolmens they might be called, have no close parallel in Assam but it is possibly significant that both the chessmen monoliths at Dinapur and the stone urns of N. Cachar have their domes incised with cross lines like the caps of the mushroom dolmens, while the Khasi monoliths sometimes have a round stone superimposed. It may be added that there was a close parallel to Dinapur chessmen to be found in one or two of the carved pillars at Lohazdagga in Chota Nagpur. The holed dolmens of Southern India have no directly corresponding parallel in Assam, but it is possible that the reason for the existence of the hole is to be inferred from the Kuki custom of inserting a bamboo into the grave (sometimes stone lined) to provide for the ingress and egress of the soul, a custom which appears again, also in association with monolithic work, in Madagascar. There is, however, no known parallel in Assam to the stone cist burial described from Jewurgi in Central India which is apparently not dissimilar from some South Russian burials possibly of some proto-nordic association. Nor is there anything in Assam that corresponds to the baked clay cist and capstone of the Hyderabad burials, though parallels can be found to the ring of stone that surmounts the grave and the occasional menhir of the Hyderabad burial areas. There is no precise parallel to the circle of menhirs of N. India in which marriage processions stop to dance, though circles of flat stones are put up to commemorate deceased persons who have been particularly rich and prosperous and have therefore high fertility value, and at Gwilong or Togwema in the Manipur State (for instance) dancing, swimming and wrestling take place inside a group of menhirs in honour of the dead at one of the agricultural festivals of the year, and in Angami villages it is common for the "pullers" of phallic wooden to stop and dance in what are known as "pools", open spaces of the village often associated with stone monuments.

The theory is advanced that all these customs are associated with a conception of life as a material and finite substance, a conception which leads logically to head hunting, cannibalism and human sacrifice as means of obtaining life-matter. It is well known that primitive languages are exceedingly poor in abstract terms; abstractions are therefore almost certainly foreign to primitive thought. It is suggested that the first conception of life is likely to have arisen from an attempt to comprehend death and the obvious but not easily explicable difference between a living man and a corpse. By a savage, unable to grasp any conceptions but those of concrete and finite matter, life would naturally be regarded as a finite material substance separable from the body and hence a wide field of speculation leading on the one hand to the practice of human sacrifice and other such means of obtaining life-matter, and on the other to the Vedantic philosophy which regards the body as a mere shell to house the soul, and only one of many such. It is suggested that this philosophy of life originates in the pre-Aryan civilisation of India, probably of Mediterranean or Syrian origin.

Letters to the Editor.

Hydro-Electric Schemes in India.

I WAS very much interested to read a letter by Dr. H. E. Watson on Hydro-Electric Schemes in India, in the August issue of the *Current Science*.

In general, the note appears to have been based on certain illusory defects. But, however, in the following brief note a few explanations have been given which will show that the adoption of 25 cycle frequency by the Mysore Government is not handicapping them as pointed out. In fact, it will be clear that it is no handicap at all.

The chief points raised in the note referred to are:—

(1) Defects regarding linking Mysore in future with the rest of India in case a grid system develops.
(2) The handicap which Mysore will be having in case railway electrification is taken up.
(3) Effect of 25 cycle lighting on the eyes of the villagers.

1. No doubt most parts of India are adopting in general 50 cycle system for the power generation and distribution system. The existing 25 cycle system in Mysore is due to the fact that the scheme was started long before any other scheme in India had been taken up. But this does not isolate us from the rest of India. There is machinery available to link the 25 cycle system with 50 cycle system if we want to do so and the object of such a linking in general is to utilise the spare power available during off peak-loads from one station to other stations where the load demand is more and the station by itself is incapable of meeting it. In the case of Mysore, such a spare power during off peak-load hours to the extent of about 25 per cent of its capacity can be made available for other systems when the grid system is adopted by such a machinery. The cost of such a machinery will be about one per cent of the cost now involved in changing the whole system to 50 cycles. In view of the above flexibility available it is but natural that it would be wasting money if an attempt is made to change the equipment so that the general supply becomes 50 cycles.

The next important point which prevents any such scheme being adopted is the point of view of the consumers who have purchased motors and other machinery suitable for 25 cycles whose equipments will have to be replaced at departmental cost if such a frequency change is adopted and the cost of such an arrangement obviously is prohibitive.

2. The difficulties, enumerated by the writer, that Mysore would be experiencing in case A. C. electrification of railways is adopted are not real. It is an established fact that the use of direct current for traction purposes has many distinct advantages and many of the electrifications in India have adopted D. C. system. From a perusal of the recent advancement made in the design and satisfactory operation of mercury arc rectifiers it will be seen that the recent experiment on A. C. electrification, which claims almost equal flexibility with the D.C. electrification, is further set back by the advantage gained in the natural characteristics of the rectifiers which, probably, will permanently claim superiority for D. C. electrification over A. C.

electrification of railways and thus the question of A. C. electrification may permanently be postponed.

From the above it can be seen that if Mysore intends electrifying its railways it will have to adopt D.C. system and when D.C. system is adopted no question of frequency arises and Mysore will not be handicapped in any way.

3. The question of the effect of low frequency illumination on the eyes is a point which I do not want to answer as it is beyond my sphere of activity. But the following short explanation will establish the fact that the rural areas have gained to a large extent at a small sacrifice if the 25 cycle lighting is considered harmful at all. The amenities of life resulting from the electrification of a town were only within the reach of the people living in Bangalore and Mysore. It was the desire of the present Dewan to see that these amenities were made available to the ryots in villages and the people in other head-quarters, as they form a larger portion of the population of the State. But there were two difficulties to be surmounted :—

(*a*) The ryots, as a rule, were poor and could not afford to pay for the amenities at the same rate as the people in Mysore and Bangalore could afford to do and the Municipalities were agreeable to get their town electrified provided it did not cost them very much more than what it would cost them at present to maintain kerosene lamps. This, of course, is due to their poor condition.

(*b*) On the other hand, Government could not undertake such works and invest large capital where the return was very low.

Thus, the department was called upon to find a solution for the two difficulties mentioned, and on careful planning it was found that if the same distribution mains are adopted to carry power load during day and lighting load during night the capital cost involved in the electrification of a town would be considerably reduced, and it was also found out that if the capital cost was reduced by this means the Municipalities were capable of giving a revenue which would be reasonable on the part of Government to invest the capital involved. Thus, it was adopted and 25 cycle lighting had to be resorted to. But this point in the design has been kept in view that when the lighting load improves in each of the sub-sections the department will have to install frequency changer sets converting the existing lighting system to 60 cycles and maintain the power supply at the 25 cycle system. This will not involve any additional expenditure on the part of consumers themselves and the increased revenue in lighting installations will justify the capital expenditure involved in changing the frequency from 25 to 60 cycles which is being done at present in Mysore and Bangalore.

It is hoped that the few points noted above will convince the people concerned that Mysore is not going to be an island as far as the electrification scheme is concerned as it may appear to be.

MOHAMED HAYATH.

Bangalore,
September 14, 1933.

A Triploid Plant in Rice (*Oryza sativa*).

IN the fourth generation of a cross between two varieties of rice, an abnormal plant was noticed characterised by marked sterility with only five seeds setting, out of nearly 800 spikelets. This plant on cytological examination proved to be a *triploid*. This is the second instance of the occurrence of triploidy in rice, the only other recorded case being in Japan where Nakamori (1932)[1] observed a triploid plant in the eighth generation of a cross between two varieties and determined its nature by noting 36 chromosomes in root tips.

Aceto-carmine smears were employed to study the meiosis of this plant. At Diakinesis, 12 trivalents are usually observed, though occasionally cells are met with, where the third member of one or more groups appear unassociated with its homologues (Fig. 1). At metaphase (Fig. 2) normally the 12 groups arrange themselves on the equator and very early in the anaphase the members of the trivalent groups disjoin into distinct units and assort apparently at random to the poles. In the material so far examined the distribution of the chromosomes to the poles was found to be either 18 and 18 or 17 and 19. Frequently univalents are seen to split (Figs. 3 and 4) and the split halves either move to the opposite poles or to the same pole. The second division is

[1] Nakamori, E., *Plant Breeding Abstracts*, **3**, No. 3, 1932, *Imp. Bur. Plant Genetics.*

more regular and the resulting microspores are of varying sizes, most of which degenerate into empty pollen grains. It is probable

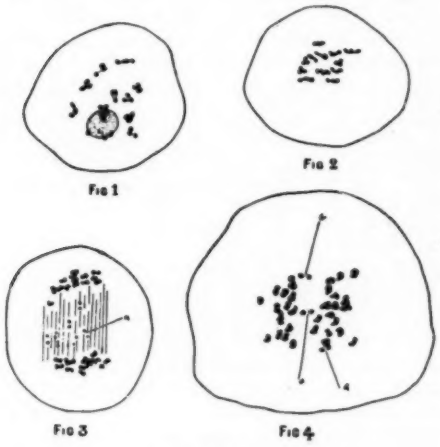

Fig 1 Fig 2

Fig 3 Fig 4

1. Diakinesis in the triploid (× 333)
2. Early metaphase triploid (× 333)
3. Late anaphase triploid (× 333)
4. Early anaphase triploid (× 500)

Note the splitting univalents (*a*) in (3) and (4).

that this plant arose by the fusion of a diploid and a haploid gamete. The investigation of this point and further detailed study of this plant are in progress and will form the subject of a separate article.

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October 14, 1933.

A Note on Fossil Angiospermous Fruits from the Deccan Intertrappean Beds of Central Provinces.

DURING the last four years the author has collected a large number of silicified angiospermous plants[1] from the Intertrappean rocks of Mohgaon Kalan, in Chhindwara District, C.P. This collection includes several specimens of *Nipadites*, trilocular and multilocular fruits.

Though Hislop[2] appears to have collected during the sixties of the last century, some globular multilocular and two trilocular fruits from similar beds in Central Provinces, description of none of these has been recorded. Moreover, there is no mention of the occurrence of *Nipadites* in his collection. The present discovery is, therefore, significant in being probably the first of its kind in India.

The present note is intended to give a brief description of the various fruit types from the Mohgaon locality. The very limited knowledge of systematic Botany has so far confronted the author in arriving at the true affinities of these angiospermous fruits and he would, therefore, through this note, be glad to invite suggestions from the systematic Botanists.

The specimens of *Nipadites* fall into two distinct groups necessitating the creation of two new species. *Nipadites compressus* Sp. nov.—These are drupes of medium size with a planoconvex or lenticular cross-section, and with 3—4 longitudinal ridges converging on apical side into an umbo and terminating on the other into a flat base. Pericarp is usually thin with smooth epicarp, finely fibrous mesocarp, and a hard endocarp. Seed is very large, only slightly smaller than the fruit and extends from base to apex reproducing the irregularities of the surface (Fig. 1).

Size.—4·7 to 8·5 cm. long, 4·0 to 4·5 cm. broad, thickest 2·0 to 2·3 cm. near the apex thinning gradually towards the base.

Remarks.—Resembles much with *Nipadites lanceolatus* Bowerbank. Represented by at least 3 complete well-preserved specimens.

Nipadites hindi. Sp. nov.—This is represented by a single, exceptionally well-preserved complete specimen. It is a drupe of moderate size (5·6 cm. long, 4·2×3 cm. in cross-section near the apex), obovate or pyramidal in shape, thickest near the apex and narrowing towards the base. The cross-section is four-sided with no two sides equal or parallel. On the apical surface a small but prominent eccentric umbo sends out four ridges to the four corners, running to and converging towards a narrow base which carries a broad round stalk-cavity. The epicarp is thin and smooth, mesocarp of

[1] Rode, K. P., "Petrified Palms from the Deccan Intertrappean Beds," *Q. J. G. M. M. Soc. Ind.*, **5**, No. 2, p. 75, 1933.

[2] Hislop, "Remarks on the Geology of Nagpur," *Jour. Bom. Br. Roy. As. Soc.*, **6**, pp. 194-204, 1861.

variable thickness is compactly fibrous while the endocarp is thin and hard. The seed is 3·5 cm. long, nearly oval or ellipsoidal in cross-section (2·2×2·8 cm.); it has large cavity partly filled with crystalline silica while its outer surface is smooth or finely reticulate (Fig. 2).

The Fossil Trilocular Fruits.—There are about a dozen specimens of trilocular fruits triangular in cross-section and with

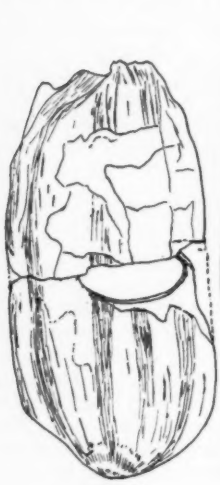

FIG. 1.

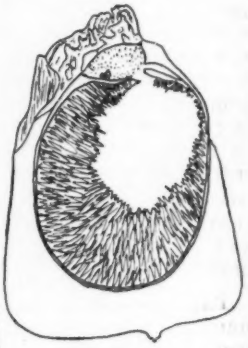

FIG. 2.

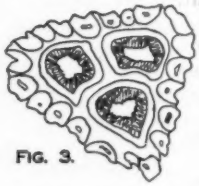

FIG. 3.

a mango-like outline in longitudinal section. The fruit contains three large elongated seeds placed vertically in three fertile loculi and separated by moderately thick septa continuous with the central column and the inner layer of the pericarp. One of the three seeds is often abortive while the well-developed seeds are more than twice as long as broad and vary in thickness as well as in outline. They are commonly hollow showing a probable albuminous nature while an outwardly directed beak-like prolongation might indicate parietal placentation which is otherwise obscure. The fruit wall is very characteristic and is traversed by numerous ribs and furrows associated with U-shaped fluid canals running the whole length of the fruit. The whole fruit was contained in a cuplike receptacle carrying the stalk of the fruit while its ventral surface reproduced the furrowed appearance of the fruit surface. There is no clear indication of the true dehiscence of the fruit.

In size the fruit is 4·0 to 4·5 cm. long, 2·5 to 3 cm. broad and nearly as much thick in the middle tapering more towards the apex than towards the base.

The fruit shows several characters common to Euphorbiaceæ and has therefore been provisionally placed in a new genus *Tricoccites* and specifically named as *T. trigonum.*

Multilocular Fossil Fruits.—There are again a number of small globular many-seeded fruits which form a group by themselves. They are nearly spherical in shape, about 2 cm. in diameter, and usually with slight depressions at the basal and apical ends. The surface is glabrous and is traversed by eight longitudinal depressions converging at the two ends. Each of the eight loculi contains two rows of about ten small elongated seeds each, with axile placentation placed in a roughly radiating manner on a stout columnar central axis. The fruit is a capsule with a loculicidal dehiscence.

The fruit shows great resemblance with *cucumites* Bowerbank in external appearance but since the internal seed arrangement in this genus is not well known it is difficult to rely on external resemblance alone.

The detailed study of these fruit types along with the discussion of their affinities will be published in due course but in the meanwhile the author will be very thankful for all suggestions helpful in arriving at the true affinities of these fruits.

K. P. RODE.

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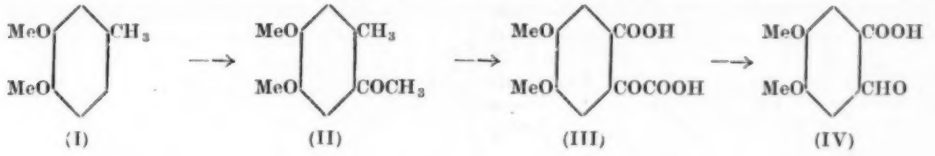
Benares Hindu University,
October 25, 1933.

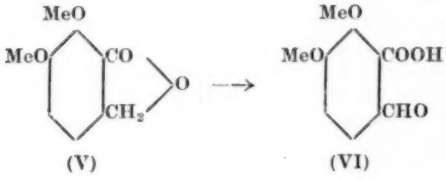
A New General Method for Synthesis of Substituted O-aldehydo Carboxylic Acids: A Preliminary Note.

THERE are very few really good methods available to-day for the synthesis of substituted O-aldehydo acids. Thus the majority of the mono-methoxy and dimethoxy O-aldehydo acids have either still to be synthesised or have been synthesised by methods which are either not of general application or are too tedious. At the time when these researches were started, only *m*-opianic acid, and opianic acid had been synthesised. The synthesis of *m*-opianic acid was first accomplished by Perkin and Fargher (*J.C.S.*, **119**, 1724, 1921) in accordance with the scheme:—



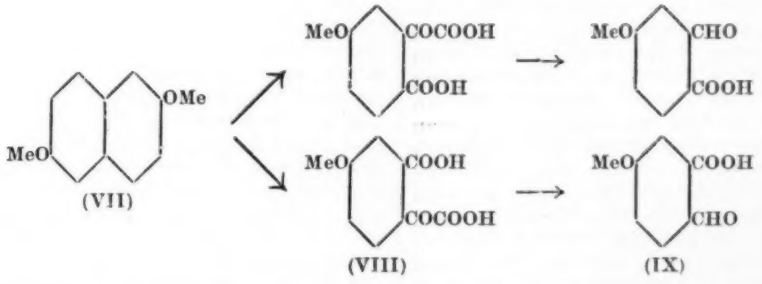
Unfortunately this excellent synthesis cannot be generally applied; firstly, because it is very difficult to introduce the acetyl group in the required position and, secondly, because the oxidation of substances of the type II, gives rise to a variety of different products which are often difficult to separate. Applications of Reimer-Tiemann reaction also cannot be used as a general method for the synthesis of O-aldehydo acids (compare Perkin and Stoyle, *J.C.S.*, **123**, 3172, 1923).

The only other method which has been tried successfully is the method of the oxidation of Phthalides. Thus opianic acid (VI) has been obtained by the oxidation of meconine.

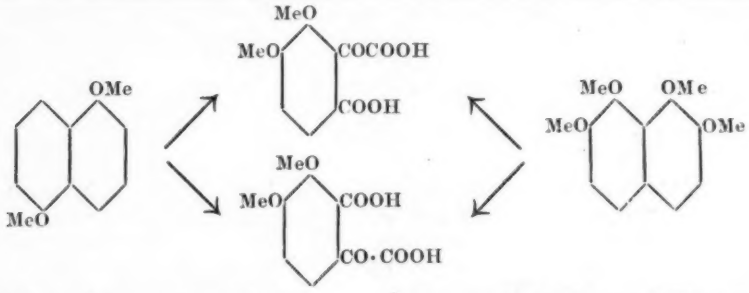


This method is also of only limited application as is shown by the failure of attempts at direct oxidation of ψ meconine (Solomon Ber., **20**, 888, 1887; Edward, Perkin and Stoyle, *J.C.S.*, **127**, 196, 1925; Chakravarti, *J. Indian Chem. Soc.*, **6**, 208, 1929) of 3:4-methoxylene-dioxy-phthalide (Perkin and Trikofus, *J.C.S.*, **129**, 2931, 1926) of 4: 5 methylene-dioxy-phthalide (Stevens and Robertson, *J. Chem. Soc.*, **131**, 2791, 1927) and of 4-methoxy-phthalide (Chakravarti and Perkin, *J.C.S.*, **197**, 1929). The present author tried a number of devices to get over this difficulty in 1929 (*J. Indian Chem. Soc.*, **6**, 209, 1929). In the case of ψ meconine, more recently still, Robinson and Greenwood succeeded in converting it into ψ opianic acid by first converting ψ meconine into β-ψ-gnoscopine and then oxidising the β-ψ-gnoscopine (*J.C.S.*, 1371, 1932).

The present author tried to devise a number of general methods for synthesising methoxy-O-aldehydo acids in 1928. As a result of this and subsequent work two general methods have been developed, one starting from the hydrindones, and the other from the substituted derivatives of naphthalene. In the latter method a symmetrically disubstituted or symmetrically tetra-substituted naphthalene derivatives are oxidised with alkaline permanganate under special conditions. To take an example, when 2 : 6 dimethoxy naphthalene (VII) is oxidised, 5-methoxy-phthalonic acid (VIII) is first formed which is readily converted into 5-methoxy phthalaldehydic acid (IX).



The idea behind the synthesis is that whichever benzene ring is ruptured during oxidation, a methoxy-phthalonic acid must be formed under suitable conditions. A number of such syntheses has been effected and an account of the synthesis of all the methoxy-phthalaldehydic acids and the three opianic acids by this method, *viz.*,



is reserved for a future communication.

SATYENDRA NATH CHAKRAVARTI.

Department of Chemistry,
Annamalai University,
Annamalainagar, South India.

October 24, 1933.

The Young's Moduli of Marble at Low Stresses.

PROF. DALY'S researches on the constitution of the earth's crust are well known. He was kind enough to send us a reprint of a paper[1] in which he has discussed the reasons for believing that the seismically effective elastic moduli of the invisible shells of the earth's crust should be systematically greater than those of the same kinds of rocks when tested by any high pressure method in the laboratory. The earthquake waves, according to him, running through a granite terrace, travel at least 20 per cent. faster than they should, if the elastic moduli (bulk modulus and rigidity modulus) were those measured at high pressures.

In spite of the above reasons, many geophysicists are assuming identity for the moduli independently of the stresses under which they are measured.

It thus seems very necessary in order to draw correct inferences as to the materials forming the shells of the earth's crust, that experiments at very low stresses such as are set up in earthquakes, be carefully performed in the laboratory.

The object of this note is to give the results of our experiments on a thin slab of marble when its Young's moduli were determined at very low stresses by the Flexure Method, using two mirrors, one at each end of the slab and a telescope and a scale to read the deflection produced when stresses were applied. The sensibility of the arrangement was such that a stress of $0{\cdot}3\times10^6$ dynes/cm^2. produced a deflection of 1 mm. on the scale. The actual dimensions of the slab were: length=45·60 cms.; breadth=7·80 cms.; thickness=0·55 cms. The density of the marble was 2·724.

In order to test the suitability of the experimental arrangements adopted, experiments on several metals, such as, iron, steel, brass, etc., were first performed. The results in these cases agreed fairly well with those given by D. K. Fromen,[2] whose curves show that ordinarily in the regions of low stresses of the order of 10^6 dynes/cm^2. for metals, the Young's modulus increases with increasing stress up to a certain limit and then decreases tending to assume a more or less constant value at higher stresses.

When, however, marble was tried, its behaviour departed completely from that of the metals. While with metals there was a rise followed by a fall in the value of the Young's modulus with increasing stress, in the case of marble this elastic constant continually fell, probably reaching a constant value asymptotically at a considerable value of the stress.

The accompanying curves show the variation of Young's modulus of marble with stress. Four different sets of observations were taken, each with increasing and decreasing stresses. Curve A fits the observational points of the 1st and the 2nd sets and curve B those of the 3rd and the 4th. There was a sudden change in the Young's modulus of the marble at the end of the 2nd set of observations, probably due to its Latent Splitting.[3] The 4th set of observations closely followed the observations of the 3rd set. In fact the curve B is practically curve A displaced by a definite amount.

[1] *Bulletin of the Seismological Society of America*, **20**, No. 2, 1930.

[2] *Phy. Rev.*, **35**, 264, 1930.

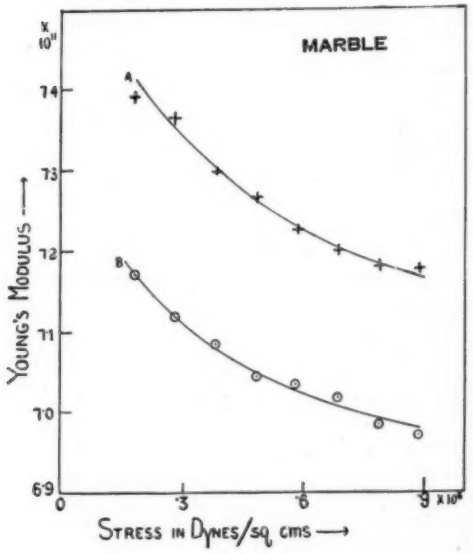
[3] *Nature*, **17**, Jan. 17, 1931; *Bulletin of the Patna S.C. Phil. Society*, **3**, Jan. 1933.

These curves can be fairly accurately expressed by the following two equations:—

$(E-6\cdot92\times10^{11})(S+0\cdot509\times10^{6})=0\cdot338\times10^{17}$ ..(A)

$(E-6\cdot84\times10^{11})(S+0\cdot327\times10^{6})=0\cdot167\times10^{17}$ ..(B)

where E represents the Young's modulus and S the stress.



In equation A if we put $S=\infty$, we get $E=6\cdot92\times10^{11}$ and if we put $S=0$, we get $E=7\cdot59\times10^{11}$. Therefore the % increase in E in the region of zero stress is 9·68.

Similarly, from equation B the % increase in E in the region of zero stress, comes out to be 7·46. The mean value of these % increases is 8·57.

The above estimate of the % increase in E is based on extrapolation—not a very desirable procedure, but there can be no doubt that over the regions of stress actually covered in the experiments, there is a regular increase of E with decreasing stress as suggested by Prof. Daly. It is further possible, that over the unobserved regions of low stress the Young's modulus of marble might increase faster than in our experiments, leading in the end to that % increase, which Prof. Daly suggests.

We could not pursue the experiments with other rocks as they were not available to us. It was nevertheless thought that the results obtained with marble were sufficiently instructive and that they might prove of interest to geophysicists specially.

K. PROSAD.
S. SHARAN.

Department of Physics,
Patna Science College,
October 26, 1933.

On Certain Helminth Parasites from "Chandrabora"—Russell's Viper (*Vipera russellii*) obtained from the Nizam's Dominions.

THREE distinct types of nematode parasites have been obtained from two nearly full-grown specimens of Russell's vipers examined, each nearly 116 cms. in length (without the tail, which is nearly 23 cms.), and out of which one was a ♂ that had devoured two field-mice, possibly *Mus buduga*, and the other was a ♀. The bulk of the parasites were little worms, about 2 cms. in length, slightly pinkish in colour during life, and they were *Kalicephalus willeyi* v. Linstow. A few of these worms were found inside the œsophagus, some in the stomach and many in the intestines of the vipers. Amongst the whole lot the other kinds of parasites included two examples of *Physaloptera* sp. (allied to *P. paradoxa* v. Linst.) and three females of *Rictularia* sp. (allied to *R. fallax* Jägerskiold—a parasite of rodents). *Kalicephalus*, and probably *Physaloptera*, would be normal parasites of the viper, and possibly the former may also be found in other Indian snakes. Dr. H. A. Baylis of the British Museum in a correspondence writes to us that *Rictularia*, however, is almost certainly a "pseudo-parasite" derived from animal swallowed as a prey, and the infection of these vipers with this worm is a likely consequence evidently due to the rodent-eating habit of the snakes. It may be remarked that Russell's viper is a wild feeder, preying upon fishes (less occasionally), frogs and toads, lizards, sometimes also devouring snakes (this being at least known in captivity), such as the common grass snake (*Tropidonotus stolatus*) and the young rat snake (*Zamenis mucosus*), besides small birds and rodents (rats and mice). He is of further opinion that *Rictularia* is not a genuine parasite of reptiles.

At this stage certain interesting questions arise: firstly, what is the mechanism of immunity of these worms harbouring

inside the alimentary canals of such deadly venomous snakes, and, secondly, how and where does the infection come from? In reply Dr. Baylis says, "... it seems to me a slight extension of the problem, which all internal parasites must solve, of withstanding the action of digestive fluids of the host. It is generally assumed, I believe, that worms solve this problem by continually producing some secretion which neutralises the digestive juices in their immediate vicinity. It is certainly a fact that if the worms die they lose their power of resistance and are soon digested. If this is true, then it seems to me possible that worms which live in venomous snakes may have the power of resisting the poison in the same way. But there is another aspect of this matter. I believe it has been found that the venom of snakes, however deadly when injected into blood or tissues, may be quite harmless when taken into the alimentary canal. In this case, it may also be quite harmless to an uninjured animal bathed in a dilute solution of it. Again, the poison may, by the time it reaches the parasites, have been so altered chemically as to have lost all its properties."

"With regard to the source of infection with these worms," he states, "*Kalicephalus* probably has a direct life-history, and infection would take place by accidental swallowing of eggs or larvæ (snakes swallow a good deal of dirt with their food). I do not think anything is known of the life-history of *Kalicephalus*, however, and it is just possible that, as in the case of some other Strongyloidea, the larvæ might be able to enter through the skin of the host. *Physaloptera* again we know nothing about from this point of view, but it belongs to a group (Spiruroidea) which requires intermediate hosts. From analogy one would expect to find its larval stages in insects or other arthropoids, and quite probably these would become re-encysted in vertebrates which preyed on the first host. This does happen with a number of Spiruroidea, so that carnivorous final hosts get infected when they in turn prey on smaller vertebrates."

We consider that very important and interesting results are expected to come out, if someone works out systematically the life-histories of the ophidian parasites of our country for which there is such a vast field, and we shall be very grateful if some fresh light is thrown on this problem, and at the same time we would be very pleased to have any further useful suggestions that would be an addition to our knowledge from those that are actually engaged in doing special work on the nematodes.

In conclusion, we take this opportunity of offering our best thanks to Dr. Baylis for kindly identifying the worms as well as for his most valuable suggestions. We are also very grateful to Moulvi Abdul Haq Saheb of our University for the gift of the fine specimen of the ♂ viper.

M. RAHIMULLAH.
B. K. DAS.

Department of Biology,
Osmania University College,
Hyderabad (Deccan),
November 1933.

Polarisation of the Fluorescent Band.

IT is well known that when a viscous solution of a dyestuff is excited to fluorescence, the emitted light is found to be partially polarised. Various experiments have been done from time to time in the hope of determining whether the polarisation is the same throughout the fluorescent band. Weigert[1] found the polarisation greatest at the red end of the fluorescent band. Wawilow and Lewschin[2] working with filters to separate different spectral regions, found the polarisation practically same throughout the band. This result was confirmed by Wawilow.[3] With aesculin in sugar and gelatine solution Pringsheim and Wawilow[4] found the polarisation greatest at the short wave side of the band. Merrit[5] confirmed the observations of Wawilow and Lewschin in a recent communication.

In view of the contradictory nature of the previous experiments, a detailed investigation was undertaken by us. The experiment was performed with a all-glass spectrograph which had been calibrated for its polarisation by the well-known method.[6] The light from a monochromator after being polarised was allowed to be incident on the fluorescent solution. The transverse fluorescent radiations were focussed with a lens of long focal length on the slit of the spectrograph. By using a suitably oriented nicol in front

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[1] *Phy. Zeit.*, **23**, 232, 1922.
[2] *Zeit. Phy.*, **16**, 135, 1923.
[3] *Zeit. Phy.*, **32**, 721, 1925.
[4] *Zeit. Phy.*, **37**, 705, 1926.
[5] *Phy. Rev.*, **36**, 1386, 1930.
[6] *Ind. J. Phy.*, **6**, 193, 1931.

of the slit and a Hertmann's diaphragm, the two principal components of the fluorescent radiations can be spectrographed side by side in juxtaposition; the times of exposures are suitably adjusted for equalising the two components as they appear in the spectrograms. A glance on the spectrogram shows that the two components are equally intense throughout the spectral region, showing that the polarisation is the same for the different regions inside the fluorescent band.

At first we investigated a number of dyestuffs in glycerine and gelatine and found the polarisation same throughout the band. Recently we have investigated a number of simple organic compounds—sodium salicylate, ortho benzoic acid, β-naphthylamine in glycerine solutions and found the polarisation same throughout the fluorescent band.

S. M. MITRA.

Physics Laboratory,
Dacca University,
November 2, 1933.

Effect of Cooking or Storing Food in Metallic Vessels.

THE increasing popularity of the use of metallic vessels, particularly in South India, for cooking and storing articles of food has now led to serious problem, which requires careful investigation. Some of the food preparations like *Rasam* or pickles are rich in salts and highly acid (as compared with similar preparations in most parts of the world) and are being cooked or stored in aluminium, lead, brass (tinned or otherwise) or bronze vessels, so that quite considerable quantities of the corresponding metals pass into solution and are thus consumed. The effect of such metallic contamination may not be immediately felt, or perhaps, even in a single generation, but their ultimate effect will have to be carefully considered in the interest of the future generations. The present investigation was undertaken with the object of throwing some light on the above and related problems. The following observations may be of interest:—

Tinned brass vessels are extensively used in Southern India for preparing acid foodstuffs like *Rasam* and *Sambar*. The following figures for representative specimens of *Rasam* (clear soup) from a hotel will speak for themselves: 5·2 parts per million of tin; 1·0 parts of lead; 4·6 parts of aluminium; 12·0 parts of iron and 3·6 parts of copper.

Young rats, weighing 40–45 grms. maintained on a diet of rice and *Rasam* prepared in newly tinned brass vessel with supplement of Vitamin A and B declined and

Top.—Rat on normal diet (Rasam and Rice).
Middle.—Rat on the same diet cooked in aluminium vessel.
Bottom.—Rats on the same diet cooked in brass vessel tinned inside.

died in the course of a month. Similar animals fed with the same diet prepared in aluminium vessel made slow growth in the beginning but developed normally at a later stage.

Fairly grown-up rats weighing 75–80 grms. kept on the same diet prepared in tinned brass vessel did not die but their growth rates were much lower than those of similar animals fed with diet prepared in aluminium vessel.

Lactic fermented milk kept in aluminium vessel for 18 hours had an aluminium content of 11·12 parts per million while that prepared in glass vessel contained only 0·45 parts per million. Rats maintained on curd from 20 c.c. of milk prepared in aluminium vessel supplemented with wheat *chappati* had normal growth, kept up healthy appearance and grew equally well as those getting the same quantity of curd from glass vessel.

The practical significance of the above and related observations is under investigation.

The researches have also been extended to the study of the effects of cooking or storing food in different other types of metallic vessels.

N. C. DATTA.

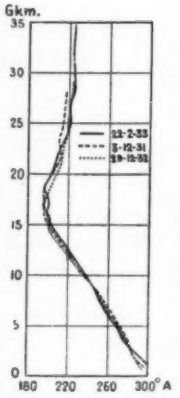
Department of Biochemistry,
Indian Institute of Science,
Bangalore,
November 6, 1933.

Some Exceptionally High-Sounding Balloon Ascents at Poona and Temperatures in the Stratosphere over the Tropics.

DIRECT observations of temperature in the upper atmosphere above 25 km. are very scanty. From an analysis of temperatures obtained from sounding balloons in different parts of the world, it is known that at a height of about 25 km., temperature all over the earth is more or less uniform being about −55°C. Experiments on the reflection of explosive sounds from the upper atmosphere which have been carried out in recent years in Europe have led to the conclusion that temperature again rises to that near the ground at a height of about 40 km.

Special efforts at increasing the height reached by sounding balloons have been made by A. Wigand[1] of the Deutsche Seewarte, Hamburg, who has recorded five ascents which went above 25 km., the greatest height reached being 35·9 km. Wigand found that there was only a very small increase of temperature between 25 km. and 35 km., the value at the highest point being near −46°C.

The accompanying figure which gives the height-temperature curves obtained from three ascents made at Poona in 1931-33 shows that in the tropical stratosphere, the temperature goes on increasing with height up to about 30 gkm.[2] and that even at 34 gkm., there is no evidence of any large rise of temperature. All the ascents were made within one hour before sunset so that the top part of the records would have been traced after sunset and would not have been affected by insolation. The temperature at the highest point was −49°C. No experiments have been made in the tropics on the reflection of sound waves from the stratosphere; but if it is assumed that the height of reflection is about the same as in temperate latitudes, the rate of rise of temperature should be very high immediately below the reflecting layer.



In a recent communication to *Nature*[3] Messrs. F. W. P. Götz, G. M. B. Dobson and A. R. Meetham have stated that observations at Arosa in Switzerland on the spectrum of the light received from the clear, blue zenith sky as the sun is rising or setting show that the average height of ozone there is about 20 km. which is much lower than the previously estimated heights (40-50 km). This conclusion gives support to the view[4] that the persistent rise of temperature between 18 and 25 km. in the tropical stratosphere is due to the presence of ozone. Attention may also be drawn to the fact that while in temperate latitudes, the temperature of the tropopause increases when its height lowers and *vice versa*, the height of the tropopause in the tropics does not show any tendency to rise above 17-18 km. in spite of large variations of temperature.[5]

The sounding balloons used in the above flights were made of 'Vulpro' tissue,[6] at the Upper Air Observatory, Agra.

K. R. RAMANATHAN.

The Meteorological Office,
Poona,
November 7, 1933.

Vertebral Centra of *Typhlops braminus*.

MOOKERJEE in his note 'On the Peculiar Apertures in the Vertebral Centra of *Typhlops braminus*'[7] states that he 'could

[1] A. Wigand, *Beitr. zur. Phys. der fr. Atmosphare*, **17**, p. 286, 1931.

[2] 1 gkm. at the latitude of Poona=1.021 km.

[3] F. W. P. Götz, G. M. B. Dobson and A. R. Meetham, *Nature*, Aug. 19, p. 281, 1933.

[4] K. R. Ramanathan, *Nature*, June 1, p. 834, 1929.

[5] *Memoirs*, Indian Meteorological Department, **25**, Part V, fig. 9, 1930.

[6] G. Chatterjee, *Nature*, Nov. 23, p. 793, 1929.

[7] *Proc. Zool. Soc.*, Part 2, 1933.

not get any reference to their presence in any of the previous literature'. Owen refers to these apertures in his *Comparative Anatomy of Vertebrates*, Vol. I, 1886. He mentions, speaking of the vertebræ of Ophidia, at page 53 of the book, that 'a vascular canal perforates the under surface of the centrum and there are sometimes two or even three smaller foramina.' Mookerjee's observations confirm Owen's statement for Typhlopidæ.

S. G. MANAVALA RAMANUJAM.

Presidency College,
Madras.
November 1933.

[Mr. L. S. Ramaswami of Bangalore has, in a communication sent to us, drawn our attention to the same reference.—ED., *Cur. Sci.*]

Research Notes.

Silicosis.

SILICOSIS is mainly a lung disease counting a high toll among the gold miners, sand blasters and quarry-men. Silica enters the lungs in large amounts as fine dust particles causing there the development of fibrotic nodules extending, in course of time from the midline to the periphery, inducing in men a pre-disposition to tuberculosis. A review of the theories on silicosis along with the rôle of silica in the system is presented by Dr. King (*Canadian Chem. and Metallurgy*, **17**, 146, 1933). According to Hefferman, silica gets embedded as the hydrosol in the phagocytes which become consequently vacuolated and die, the process spreading from cell to cell. The mechanism of this dehydration is not adequately studied. Policard considers a mineral impregnation to take place resulting in a sort of mummification of the protoplasm. According to King the silica content of the urine is influenced by the nature of the diet being larger when animals are fed with oats, cabbages, etc., and smaller on a diet of white bread and tomato juice. Silica is present as an invariable constituent of the protoplasm in the white and yolk of the eggs of birds, and other embryonic mammals. Direct administration of silica as finely powdered quartz into the stomach results in an enhanced output of this material in the urine. This value is still more abnormal when it is employed as neutralised sodium silicate. Silicic acid in saline, in dilute solutions, when given intravenous continuously for several hours, produces very high values in the urine. When this is, however, replaced by a fine suspension of particulate silica, much of this constituent is not detected in urine, but the urine becomes bloody resulting in anuria followed by death. The kidney had, however, a normal silica content while the spleen had a figure far above the normal. Organic derivatives of silicic acid affected the composition of the blood and urine without evil effects, suggesting a high tolerance of silica in this form. The author finally concludes that the increased output of silica is not apparently through the kidneys.

Corrosion of Tin and Iron.

CORROSION of tin and iron in tin cans used as containers for acid foods such as fruits is the theme of a contribution by Lipsett (*Canadian Chemistry and Metallurgy*, **17**, 171, 1933). In tin cans the iron is protected by a coating of relatively inactive metals such as tin, but where this coating has worn out, corrosion sets in causing pinholes. The occurrence of these spots in tin containers is explained as due to electrochemical action, the dissolution of iron at the anode taking place consequent on the evolution of hydrogen at the cathode and in view of the limited exposure of iron, the attack is strong resulting in the formation of a deep hole. Thus one would conclude that tin cans do not serve as ideal containers. The observed facts are quite contrary to our expectations for which an explanation has been sought in this communication. The coating of tin has a protective action on the exposed pinholes but the element that seems to suffer due to corrosion is tin itself. It is common nowadays to use enamelled tin cans to preserve coloured fruits, since their colour is bleached badly in these containers. Strangely enough, such decolorisation is hastened in the well lacquered holders. A third anomaly is traceable to increased acid content of the fruits whereby less damage is caused to the tin, in striking contrast to the general view that corrosion is accelerated by increased acidity. Explaining the first

of these anomalies the author draws attention to the fact that when tin and iron are held in electrical contact in an acid solution, the amount of tin dissolved is far greater than it would otherwise be, while under the same conditions iron behaves in exactly the opposite way. The electric potential between the tin and the iron is reversed and the iron is cathodic to the tin. The tin-iron couple, under anærobic conditions, behaves in a manner wherein the hydrogen liberated through the action of acid on tin protects the iron from being acted upon. Potential measurements carried out by the author confirm these practical observations. Coming to the products of corrosion, it is found that a very large part of the tin dissolved is in the insoluble state. It is also found that hydrogen accumulates in the sealed tins after utilising the oxygen of the air originally contained therein. The contents may be good to eat being sterile but the gas accumulation causes the cans to swell. The increased corrosion in the case of lacquered containers is not due to the action of acids on the lacquer, but to defective make up of the holders. In practice, tin sheets are lacquered before stamping out the ends, with the result that weak spots and abrasions are created in the process of stamping, in both the lacquer and tinned plate itself. It is then easy to understand the causation of leaks, especially at the ends occurring chiefly in the countersink. The tin here does not protect the iron, since the surfaces of tin and iron exposed to the acid are more or less the same. Whether the lacquer film favours this heavy corrosion is a point for further confirmation. It is hoped that this physico-chemical aspect will receive due attention in the several problems relating to food and food containers in whatever manner these are used.

V. I.

Some Factors affecting the Electrolytes of the Starch Granules.

THE starch granule is generally regarded as consisting of two parts, α-amylose or amylopectin forming the outer insoluble layer and β-amylose constituting the soluble inner part. The amylopectin fraction contains phosphorus and the fact that dephosphorisation considerably decreases the viscous properties of the materials which is restored by rephosphorisation suggests that phosphorus profoundly influences the viscosity of starch. Other electrolytes have been detected in starch granules from various sources (some of them may be regarded as adsorbed impurities) and the relationship between them and the viscosity of starch is not well understood. The problem is one of great practical importance as starch is extensively employed in arts and industries. In a paper published in the *Journal of Agricultural Research* (**47**, 179-91, 1933) Edwards and Ripperton have reported their findings regarding the variation of phosphoric acid and cations in starches of various origins, the nature of their binding and the possible significance of the results in practical industrial uses of starch and plant physiology. Analysis of a large number of commercial starches showed that phosphate was always present and gave characteristic values. The other constituents, calcium, magnesium, etc., varied within very wide limits. In the case of edible canna rootstocks it was shown that the observed drop in viscosity was correlated with the decrease in potassium and increase in calcium. This was not, however, true of stored potatoes. *In vivo* studies of the relationship between electrolytes in sap and the electrolytes associated with starch showed that there was no direct chemical equilibrium between the two. The conclusion that ionic absorption is specific and is not controlled by the electrolyte-concentration of the sap appears to be justified. Starch may function as a store for inorganic materials which the plant can utilise when needed. During germination, for instance, the phosphorus associated with starch is made available possibly in organic combination needed for early growth.

Intermediate Products and the Last Stages of Carbohydrate Breakdown in the Metabolism of Muscle and in Alcoholic Fermentation.

IN the course of a lecture delivered in the Biochemical Laboratory, Cambridge (Reported in *Nature*, **132**, 337–340; 373–375, 1933) Dr. Otto Meyerhoff has summarised the present status of our knowledge concerning the anærobic carbohydrate breakdown in lactic acid formation in muscle and in alcoholic fermentation. Esterification of the phosphates has been generally regarded as the first step in these processes. The stages following esterification, however, have

formed the subject of several important investigations.

From the living yeast and other intact cells and tissues as also from the muscle extract it is possible to isolate a hexose monophosphoric acid ester, which is actually a true equilibrium mixture consisting of about 70% aldose monophosphoric acid and 30% ketose monophosphoric acid. Embden observed that the addition of sodium fluoride inhibited the formation of lactic acid in muscles, at the same time producing increased quantities of hexose diphosphoric acid. Subsequent work of Lohmann (1930) showed that this acid was a rearrangement product of the ester isolated by Harden and Young, from yeast-press juice. Under conditions defined by Lohmann, glyceric acid monophosphoric acid (phospho-glyceric acid) is also produced and treatment of phosphoglyceric acid with minced muscle produced pyruvic acid, and α-glycero-phosphoric acid (a reduction product). Embden further observed, that simultaneous addition of phosphoglyceric acid and α-glycero-phosphoric acid to muscle tissue caused an increased formation of lactic acid twice as much lactic acid being produced as pyruvic acid disappeared, while neither pyruvic acid alone nor α-glycero-phosphoric acid was able to produce lactic acid when added to carbohydrate-free muscle extract. Thus the reaction is represented by—

$$\begin{array}{lcl} CH_3 & CH_2OH & CH_3 \\ | & | & | \\ CO & + CHOH \rightarrow & 2.\,CHOH + H_3PO_4 \\ | & | & | \\ COOH & CH_2O.PO_2H_2 & COOH \end{array}$$

The inhibiting effect of sodium fluoride in lactic acid production from carbohydrates is due to the inhibition of that stage of the reaction responsible for the splitting off of phosphoric acid from phosphoglyceric acid. If, therefore, excess of pyruvic acid and α-glycero-phosphoric acid be added to muscle extract, as also enough fluoride to stop completely the anærobic breakdown of glycogen and hexose diphosphate, lactic acid is formed, and in the same amount as would be produced without the addition of fluoride; but the disappearance of pyruvic acid and formation of lactic acid are equivalent; thus—

$$\begin{array}{lcl} CH_3 & CH_2OH & CH_3 \quad COOH \\ | & | & | \quad | \\ 2.CO + & CHOH \rightarrow & 2.CHOH + CHOH \\ | & | & | \quad | \\ COOH & CH_2O.PO_3H_2 & COOH \quad CH_2O.PO_3.H_2 \end{array}$$

The glycero-phosphoric acid is completely converted into phosphoglyceric acid.

The pyruvic acid and glycero-phosphoric acid do not react with each other directly to produce lactic acid, but one half is converted into triosephosphate which then undergoes rearrangement. The glycero-phosphoric acid thus produced can react again with pyruvic acid but the phosphate group of phosphoglyceric acid is not split off.

Considering the alcoholic fermentation, it has been observed that when phosphoglyceric acid is added to fresh yeast extract, CO_2, phosphoric acid, and acetaldehyde are produced. Again, when hexose diphosphoric acid is added to a fluoride containing yeast juice, the ester undergoes change and a mixture of phosphoglyceric acid and glycero-phosphoric acid in equal quantities is produced. Glucose alone is not esterified in the presence of fluoride, but the esterification takes place when glucose and diphosphate are simultaneously added to yeast juice, but the reaction stops when the quantity esterified is equal to the hexose diphosphate. Addition of acetaldehyde brings about other interesting changes. The reaction proceeds further, aldehyde is reduced to alcohol, the sugar is esterified, and converted into phosphoglyceric acid. The extent of the reaction depends on the amount of added acetaldehyde only a trace of hexose diphosphate which acts like a true catalyst being required.

$$\begin{array}{lcl} 2 \text{ acetaldehyde} & & 2 \text{ alcohol} \\ + 1 \text{ glucose} & \rightarrow & + 2 \text{ phosphoglyceric acid} \\ + 2 \text{ phosphoric acid} & \uparrow & \\ & \text{(Hexose diphosphoric acid)} & \end{array}$$

Acetaldehyde can be replaced by other reducible systems such as methylene blue. The mechanism of the reaction appears to consist of a reaction between the aldehyde and the nascent triose-phosphoric acid produced from the reaction between glucose and hexose diphosphate. The aldehyde also prevents the rearrangement of the triose-phosphoric acid into glycero-phosphoric acid so that the triose-phosphoric acid is quantitatively converted into phosphoglyceric acid.

"The difference between alcoholic fermentation and lactic acid fermentation is to be found in the fate of pyruvic acid while pyruvic acid in muscle extract is reduced to lactic acid by the glycero-phosphoric acid, in yeast, it is split up into CO_2, acetaldehyde which acetaldehyde is then reduced. This reduction is not accomplished by the glycero-phosphoric acid, but by some precursor probably the glyceric aldehyde phosphoric acid."

On the Placentation of the Harbor Porpoise (*Phocæna phocæna*, Linn.).

G. B. WISLOCKI in an important article (*Biol. Bul.*, Vol. **65**, Aug. 1933) describes the placentation of Porpoise. The existing literature on this subject is very scanty. The fœtus which is almost a fully grown one occupies more commonly the left uterine cornu and the fœtal envelopes extend into the right cornu also. But in this case, the amnion though larger than the allantois does not extend into the right cornu. The placenta is of the diffuse epitheliochorial type. Where the blood vessels are greater in number the attachment is also intense and *vice versa*. Further the characteristic features of the diffuse placenta, the presence of chorionic vesicles, are wanting. A sectional view of the umbalical cord shows the presence of vascularised stroma, resembling therefore the ungulates more than the primates. Prof. Wislocki assures us that in a future communication a detailed description of the umbalical cord, the stroma and the lymphatics will be made.

Cytology of Meiotic Cells in Schizodactylus.

C. E. MCCLUNG AND J. J. ASANA (*Journ. Morph.*, **55**, No. 1) report an interesting case of a cytological condition of the meiotic cells in Schizodactylus, an aberrant Orthopterous insect. The work of McClung and his students has established a fact that the chromosomes in this group of insects conformed to a certain type in their structure and behaviour. Obviously the case of Schizodactylus is an exception, for in certain important respects it differs from this type. Firstly, the chromosome number is astonishingly small, in fact the smallest in all Orthoptera, being only fourteen in the diploid condition. A second fact of importance is the evenness in number indicating the presence of a Y-chromosome unknown in the group except for some Gryllotalpa individuals. Another important feature in which Schizodactylus differs from other Orthopterous insects is the distinctive characteristics which make the identification of the different tetrads very easy. The fiber attachment is terminal though the larger chromosomes in the metaphase are J-shaped. The relatively small size of the chromosomes in the first spermatocyte is another interesting feature. In fact the authors think that in many respects the conditon in Schizodactylus recalls that in Chilopods described by Bouin and Blackman. The position of Schizodactylus in the group Orthoptera on the basis of anatomical characters is not clear. And the behaviour and structure of the chromosomes in this animal lend additional proof for the anomalous position of this animal.

Variations in the Oestrous Cycle of Guinea-Pig.

USING the vaginal smear technique, Thomas Nicol (*Proc. Roy. Soc, Edin.*, **53**, Pt. 3) has given excellent data for the determination of the variations in the œstrous cycle of the guinea-pig in the virgin animal, after parturition and during pregnancy. The duration of the normal œstrous cycle is about 16 to 18 days, though variations between 10 and 26 days have been recorded. Normally the vagina is closed by a thin membrane and during the period of sexual activity the orifice is kept open for about three or four days, afterwards closing again. During this period of heat the vagina is filled with a fluid which has been subjected to microscopical examination in different stages of this sexual activity. And on the basis of the vaginal smear preparations the œstrous period has been divided into four stages extending over a total period of 12 to 24 hours, ovulation occurring about the middle of this period. Observations on 368 cycles from 40 animals have yielded uniform results.

African and American Explorations.

IN the *Proceedings of the Academy of Natural Sciences of Philadelphia*, Vol. LXXXIV, for 1932, a series of articles based on the explorations into the various regions of Africa and America is reported. Besides descriptions of the African birds, the Herpetological and Avian fauna from Honduras and Fishes from Brazil, a new species of Sailfish, *Istiophorus, I. brookei*, is described from Tahiti. The account on the Reptiles and Amphibians from Honduras deals with seventeen Amphibians and twenty-six Reptiles. The ecological adaptations of the fauna at an altitude of nearly 5,000 feet, must be extremely interesting and we expect an account of this in the next issue of the *Proceedings*.

Origin and Classification of Pegmatites.

IN a recent number of the *Amer. Miner*, **18**, pp. 33-56 and 95-103, 1933, K. K. Landes

has published an interesting paper on the origin and classification of pegmatites. All theories of pegmatite origin are classified into two groups—aqueous and igneous—and further sub-divisions in each group are mentioned and discussed, especially the 'hydrothermal replacement sub-groups'. Examples of the various types of pegmatites included in the classification are given.

Contamination in Acid Magmas.

EVER since petrology, as distinct from petrography, came into its own, the rôle played by assimilation in the formation of igneous rocks has been the subject of repeated controversy. An interesting paper on 'Some theoretical aspects of contamination in acid magmas' by S. R. Nockolds appears in a recent number of the *Journal of Geology*, **41**, No. 6, wherein an attempt has been made to show what happens when foreign material is added to an acid magma and the various ways in which this material is incorporated. The author has definitely shown that "from a theoretical point of view, there are indications that diffusion into xenoliths should be accomplished by the volatile components of a magma and the simple salts which tend to travel with them, rather than by the complex silicate components." This diffusion of substance to and from a xenolith constitutes reciprocal reaction, and such diffusion will go on till it results in stabilising the mineral assemblage of the xenolith so that its mineral phases are in equilibrium with the contaminated magma. The actual gaining of various oxides by reciprocal reaction is not the only way in which the magma may alter its constitution. There are also other methods which may be loosely described as 'mechanical' by means of which the magma incorporates solid material from the invaded rock. Three main methods of incorporation may be noticed: (1) when the invaded rocks of xenoliths are not in equilibrium with the magma as regards all their phases, (2) when they do remain more or less in equilibrium, (3) when magma material is injected *en masse* into the xenoliths or country rocks at the contact.

Science News.

Mr. Muhammed Zakiuddin, M.Sc. (Alig.), Research Scholar, Aligarh, writes, "The first Society for the study of the Sciences was started by the late Sir Syed Ahmad Khan at Ghazipore in 1864. It was named the Scientific Society and its objects were:—(1) To translate in such languages as may be in common use among the people, those works of arts and sciences, which being in English and other European languages are not intelligible to the natives; and (2) To search and publish rare and valuable Oriental Manuscripts (non-Religous)".

The seat of the Society "was to be fixed ultimately at Allahabad but before the Society was set a thorough going it was to be where Sir Syed was stationed".

From 1864 the proceedings of the Society were published and an Urdu Journal was started known as *Tahzeeb-ul-Ikhlaque*—that served the Indians as *Tatler* and the *Spectator* did the Englishmen, and advocated the spirit of free enquiry and search after truth fearlessly. Later on when Sir Syed came to Aligarh, the Society was stationed where the present University Press stands. The Society showed a good deal of active service and the Duke of Argyll, the then Secretary of State for India, accepted its patronship. Mr. R. B. Qadri transferred the seat of the Society from the Gardens to the M.A.O. College in 1896, and this is the beginning of the relations between the Society and the College. In those days popular lectures were delivered and books were also published from time to time.

In 1907, Prof. Harrisson added fresh vigour to the Society at the opening of the B.Sc., Classes in the College, but unfortunately he left the College in the same year and it was not before Prof. Duncliffe took charge of the Science Departments that the Society was strengthened. In March 1915 Mr. F. D. Murad drafted a constitution for the Society pointing out that the object of the Society was to develop Scientific taste and to provide popular lectures on Scientific subjects.

About the same time Mr. Murad published the book "India's Neglect of Science and Scientific Education" giving in detail the activities of the Society.

In 1917 Prof. Dr. Wali Mohammad took the charge of the Science Departments and the Wali Mohammad Gold Medal was struck to be given for the best work done by a Science student. The activities of the Society went on, as it goes to-day and in 1920 it was registered as one of the Clubs and Societies of the University. It is interesting to note that the Indian Association for the Advancement of Science was started in 1876—12 years after the Scientific Society was started—by Dr. M. N. Sarkar.

The Society has led to other movements that has made Aligarh a hope for the future under the Presidentship of Prof. Dr. R. F. Hunter, D.Sc., Ph.D., etc., Nizam Professor of Chemistry in the University.

Side by side to the movement has developed another movement. In 1931, the erection of the New Science Laboratories (*Current Science*,

September 1933) started a new era in the history of Aligarh.

Professor Hunter inspired by the speech of Sir Abdul Qayoom published a plea for the establishment of an Association for the advancement of Science. Although at present we have got the Indian Association for the Advancement of Science it seems that we stand in need of some more such institutions that should undertake the publication of research work and memoirs, etc., the output of research in India being enormous.

The Association was started and it publishes a Proceeding that is distributed free to all the Libraries of the world.

The present President is Nawab Masood Jung Sir S. R. Masood, the Vice-Chancellor of the University.

* * *

The International Institute of Agriculture has recently issued a *Bibliography of Tropical Agriculture, 1932*, which contains a list, as nearly complete as possible, of the articles on agricultural topics of the tropics which have appeared in periodicals of all countries. In addition to the usual bibliographical particulars, a short abstract of each article is given in French and English. The material is arranged in accordance with the type of crop treated under the following 15 headings, in addition to one on agriculture in general:

Starch and Sugar plants; Oil yielding plants; Plants used for beverages; Narcotic plants; Textiles; Rubber yielding plants; Gums and resins; Plants for dyes; Perfume yielding plants; Spices; Medicinal and toxic plants; Fruits, Vegetables; Green manures, Cover crops, Shade trees; Weeds.

This bibliography, which is a continuation of that published last year for 1931, will be of inestimable value to the Agricultural Departments, the Research Stations and, in general, all persons concerned with questions of tropical agriculture.

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In the Editorial on "The Marine Fisheries of India" that appeared in our last issue attention was directed to Mr. H. T. Sorley's Report on "The Marine Fisheries of the Bombay Presidency". It is now learnt that in pursuance of the recommendations made therein steps are being taken by the Government of Bombay to devise ways and means to improve the supply of fish to the city of Bombay and to ensure its proper distribution throughout the city. As a means to this end it has been decided to take on hire a motor launch from the Royal Indian Marine and use it as a collecting boat for 3 or 4 fishing boats so that fish actually collected by the fishermen will be brought to the place of landing by the motor launch. It is also proposed to take up some apprentices from fishing community for training in the driving of motor launches so that they may not be required to employ paid drivers in case they take up the idea of converting their present sail fishing boats into power driven boats. It is later proposed to build two boats of the same size as the present sail fishing boats equipped with Diesel engines and demonstrate them to the fishermen for the actual catching of fish. This is to be done with a view to impress upon the fishermen the advantages of power driven boats over their present sail fishing boats. With the assistance of motor driven launches fishermen will be able to land fish in a fresher condition than they have been doing at present.

This demonstration will be conducted by the Fisheries Inspector who, we understand, joined his duties about the middle of October 1933. His duties will not be confined only to the demonstration of power driven boats. He is expected to act as an adviser on all fishery matters and to carry out investigations which would ultimately lead to the development of fishing industry of the Bombay Presidency on modern lines.

In this connection Zoologists all over India will be glad to learn that Dr. S. B. Setna has been selected for the post of Fisheries Inspector in the Bombay Presidency. Judging from Dr. Setna's previous record in connection with fishery investigations, the choice seems to be a happy one. From the duties assigned to this post, it seems that there will be very few opportunities for the officer to pursue any comprehensive scientific investigations on fisheries, but it is expected that in spite of these difficulties much good will result even from this small beginning towards scientific exploitation of the fishery resources of the Presidency. The experiment will be watched all over India with considerable interest.

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We have pleasure in acknowledging the receipt of the first volume of the *Journal of Osmania University College*, Hyderabad (Deccan) which embodies the results of research carried on by the members of the staff in their respective departments. The Journal is under the management of a Research Board on which the professors are represented. Principal Mohammed Abdur Rahman Khan says in the Foreword that the University derives its name from the august appellation of H. E. H. the Nizam, whose public zeal and sagacity are well known and among the staff of the University are men of recognised position in education and science. "The spirit of research has caught hold of the mind of not only the professors, but also of that of the post-graduate students of the University College" and we congratulate the University on this excellent feature of their work, which we hope will be fostered and advanced by suitable encouragement.

For the present the Journal is intended to be published annually but we expect that as matter becomes available, it will appear more often. We do not quite understand the need of a separate journal for the publication of the work done by the post-graduates. If their papers are of sufficiently high quality and are fit to be published at all, they should find a place side by side with the papers of their professors. This procedure will fill the minds of the young researchers with confidence and hopes which will encourage continuous and better efforts on their part.

We welcome the Journal and wish it a long and prosperous career of increasing usefulness. The Urdu translation of the papers will help to disseminate knowledge among a wider public and the step that the authorities have taken is in the right direction.

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Mr. M. N. Rudra, M.Sc., of the Prince of Wales Medical College, Patna, has developed a modified micro-method (see Kingsbury's *J. Biol. Chem.*, **75**, 241, 1927) for the estimation of normal urinary sugar. A 5 % solution of formaldehyde instead of 10% as in the original method is recommended.

Consistent results are obtained and the method as modified proved very satisfactory for estimating small amounts of sugar in normal urine. It is also preferable to reduce the concentration of the reagent solution to 0·6 per cent. This modified method is now being employed for estimating sugar in normal urine.

* * *

Dr. K. S. Krishnan, D.Sc., Secretary of the Indian Association for the Cultivation of Sciences, has instituted three prizes to be given to the most successful students of the Dacca University, with a view to commemorate the services of the late Mr. Ramanujam, Sir C. V. Raman and Acharya Sir P. C. Ray in the cause of Mathematics, Physics and Chemistry respectively.

* * *

"The All-India Sugar Committee appointed by the Imperial Council of Agricultural Research in India is to meet at the Imperial Sugarcane Breeding Station, Coimbatore, 14th to 16th November, both days inclusive. Coimbatore has been chosen as the place for these meetings, as the Sugarcane Station here has been responsible for increasing the tonnage of cane in the Indian sugarcane belt—through new and valuable hybrids evolved at the Station—thus rendering possible the starting of additional factories in India. The direct stimulus to the opening of new factories in this country was the levy of a substantial tariff on imported sugar for a period of fifteen years on the initiative of the present Sugar Committee almost immediately after its inauguration in the year 1929."

"The Agenda of these Coimbatore meetings include important subjects such as the utilisation of molasses for power alcohol, results of experiments with cane crushers of various types, schemes for improving different products from sugarcane such as gur or jaggery, desi sugar and vacuum pan sugar, proper organisation for the full development of the Indian Industry, various investigations on the life cycle of sugarcane and its breeding, fixing of prices for cane delivered to the factory and zoning of definite areas to particular factories.

"Besides the Members and Co-opted Members scattered all over India, a large number of non-official visitors are expected to attend the meetings. Persons attending include leading business men, sugar technologists, sugar factory owners, sugarcane growers and Directors of Agriculture and Industries from the important Provinces."

* * *

An ordinary monthly meeting of the Asiatic Society of Bengal was held on Monday 6th November when Kavya Tirtha Ram Dhan, Dr. M. S. Krishnan, Mr. Arthur Lennox Coulson and Miss Gerta Hertz were elected ordinary members. The following papers were read and discussed:—1. *A few types of Sedentary Games of Lower Bengal* by Jatindra Mohan Datta; 2. *Sedentary Games of India* by S. L. Hora; 3. *Worship and Propitiation of Wild Animals at Uttarbhag, Lower Bengal*, by S. L. Hora; 4. *Worship of the Deities* Ola, Thola *and* Bon Bibi *in Lower Bengal* by S. L. Hora; 5. *On a few Ancient Indian Amulets and Charms* by Sarat Chandra Mitra; and 6. *Some Insects found associated with the Bitter-Gourd*, Memordica charantia *Linn* (*Cucurbitaceæ*) *in Calcutta* by S. Ribeiro.

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Forest Research in India. 1932-33.—The Report of the Forest Research Institute, Dehra Dun, which records the progress achieved during the year 1932–33, is a document of considerable interest.

In spite of drastic economy several problems of immediate value received attention, due regard being paid to problems of importance to forest departments in the provinces and problems connected with the growth of timber and utilisation of available forest produce. The publication of the manual "Commercial Timber of India" by Sir Ralph Pearson and Prof. H. P. Brown, both of whom were formerly connected with the Forest Research Institute, makes a distinct advance on the economic side of Indian Forestry. Mr. V. D. Limaye has prepared a report recording the mechanical and physical properties of 140 Indian Timbers. In the wood preservation section Mr. Kamesam carried out researches on the fixation of copper in wood.

Several other important researches were carried out during the year and results of practical utility have been obtained. Mention may be made of the work of the Paper Pulp Section which has established that bamboos (*Dendrocalamus strictus*) that have flowered and died yield a higher percentage of cellulose and paper than green culms, although drastic digestion is needed.

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We acknowledge with thanks the receipt of the following:—

"Nature," Vol. 132, Nos. 3333 to 3336.
"The Chemical Age," Vol. 29, Nos. 742 to 745.
"Canadian Journal of Research," Vol. 9, No. 2.
"The Journal of Chemical Physics," Vol. 1, No. 9.
"Berichte der Deutschen Chemischen Gesellschaft," Jahrg 66, No. 9.
"Natural History," Vol. 33, No. 5.
"Journal of Agricultural Research," Vol. 47, Nos. 1, 2 and 4.
"Experiment Station Record," Vol. 68, Nos. 1 to 5.
"Experiment Station Record," Vol. 69, No. 2.
"Science Progress," Vol. 28, No. 110.
"The Review of Scientific Instruments," Vol. 4, No. 9.
"Indian Forester," Vol. 59, No. 10.
"Medico-Surgical Suggestions," Vol. 2, No. 9.
"Bulletin of the State College of Washington, Agricultural Experimental Station," Bulletin No. 286.
"Contributions from Boyce Thompson Institute," Vol. 5, No. 3.
"Indian Journal of Physics," Vol. 8, No. 2.
"Journal of the Russian Chemical Society," LXV, Tom III, Livre 3.
"Journal of Entomology and Zoology," Vol. 25, No. 2.
"Journal of Agriculture and Livestock in India," Vol. 3, Nos. 1 to 5.
"The Indian Journal of Agricultural Science," Vol. 3, Nos. 1 to 4.
"The Indian Journal of Veterinary Science and Animal Husbandry," Vol. 3, Pts. 1 and 2.
"Annual Report of the Imperial Council of Agricultural Research" for the year 1931-32.
"Review of Agricultural Operations in India," 1929-30 and 1930-31.

Reviews.

RECENT ADVANCES IN ATOMIC PHYSICS. By Prof. Gaetano Castelfranchi. Approved translation by Dr. W. S. Stiles and Dr. J. W. T. Walsh. Vol. 1: Atoms, Molecules and Electrons, pp. xii + 360 + 12. Vol. 2: Quantum Theory, pp. xii + 400 + 12. (London: J. and A. Churchill, 1932. 15*s*. each volume.)

Prof. Castelfranchi's two volumes on "Recent Advances in Atomic Physics" are the latest in the field of books on Modern Physics. In the first volume we find very clear and logical accounts of the Kinetic Theory, Fluctuations, Electrons and Positive Rays, Isotopes, X-Rays and the Atomic Number, Crystals, Radioactivity, and the Atomic Nucleus. In the second volume are treated subjects like Radiation and the Quantum Theory, Spectroscopy, Stark and Zeeman Effects, Specific Heats, Photoelectric Effect, Compton Effect, Magnetism, Wave Mechanics and Quantum Mechanics, and the New Statistics. The method of treatment and the choice of subjects have an originality and charm of a high order. The writer has rightly laid emphasis on the experimental and technical side of the topics and developed a coherent account of the recent advances in Atomic Physics with as little mathematics as possible "avoiding all that is obstruse, all unnecessary elaborations of the argument, and all lengthy calculations which hinder a rapid comprehension of the subject as a whole by obscuring it in a mass of detail." In the second volume the last two chapters on Wave Mechanics and Quantum Mechanics and the New Statistics are particularly well executed. We feel confident that these two volumes of Prof. Castelfranchi can be recommended with profit to Honours undergraduates who want to have a grasp of the essential developments in Modern Physics. The bibliographies given at the end of each chapter will be of use to the more advanced student of Physics who wishes to have a deeper insight into the problems dealt with in the book. There are unfortunately some misprints—some of them obvious at first sight—which we hope will be looked into and rectified in the next edition of these two volumes. Leaving aside these slight imperfections, we must congratulate the author for the excellence with which he has presented to the reader a clear and concise account of the trend of developments in Atomic Physics. The translators deserve commendation for having done a real service to the English reading public by so ably bringing out the charm of the original Italian Edition.

WIRELESS TELEGRAPHY AND TELEPHONY. By W. Greenwood. Second Edition. (University Tutorial Press. Pp. 307. 5*s*. 6*d*.)

As a book for the serious beginner, Mr. Greenwood devotes an unnecessary amount of space to radio communication methods and apparatus which are either obsolete or fast becoming so. Chapters III and IV dealing with spark, arc and alternator methods of generating high frequency currents and of reception by different types of coherers could be almost completely omitted along with matters of merely historic interest as in Chapter V and elsewhere in the book.

The treatment of the physics and physical action of the thermionic vacuum tube as rectifier, amplifier and oscillator is inadequate and disappointing. There is complete absence of all necessary mathematical treatment. There is not even one diagram of a receiver circuit using a screen grid tube or pentode, let alone the later types. There is no mention of master oscillator driven systems; it is always the self-oscillator that gets connected or coupled to the antenna. Nor is there any information on the superheterodyne.

While Fleming, de Forest and Stead are mentioned for their contributions in the development of the thermionic vacuum tube, the names of Richardson, Langmuir, Thomson and others are not to be found.

Chapter IX gives brief descriptions of the different directional methods of transmission and of reception while the succeeding one deals with aerials and earth systems. In view of the rôle it plays in radio wave transmission, a short discussion on the ionosphere should have been included in Chapter XI.

The question of frequency measurements calls for more adequate treatment than what is contained in paragraph 170. Those who have even a brief experience with the working of the Duddell thermo-galvanometer will not readily agree with what Mr. Greenwood has to say on this instrument on page 236.

The last chapter deals with circuit analysis and will be found helpful by the beginner.

A few worked examples at the end of each chapter would have increased the use of the book as a text-book.

In the next edition, one hopes that Mr. Greenwood will forget or push back the experience he gained during his stay with the British Navy and present instead the results of his valuable study and experience as a research engineer of the British Broadcasting Corporation.

One hopes too that terms like "mutual induction" (page 28), "Oscillating Current" (page 28) and statements such as "Light and electromagnetic waves are the same forms of energy but of different wavelengths" (page 41) will not find any place.

The printing and general get-up of the book leave nothing to be desired; the diagrams stand out clear from the text and are a help to the reader.

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COMITE CONSULTATIF INTERNATIONAL DES COMMUNICATIONS TELEPHONIQUES A GRANDE DISTANCE. (Plenary Session, Paris, 14-21, September 1931. English Edition issued by the International Standard Electric Corporation, London, 1932, 362 pages. Price 21*s*.)

Though the C.C.I. is only a consultative body but nine years old its membership includes practically all the important telephone administrations of the world; its conclusions and recommendations, therefore, carry great weight.

This handsome volume of 362 pages forms the report of the Paris meeting in 1931 of the C.C.I. and presents an authoritative and comprehensive picture of the present status of long distance international telephone communication by wire and radio.

On the administrative side, the recommendations relate to organisation, operation, tariffs, priority of calls, traffic statistics, etc.

On the technical side are considered questions relating to maintenance, operation and supervision of lines and installations; technique and apparatus for a variety of telephone transmission measurement; reference and working standards for telephonometric measurements; examination of the different national systems in relation to international telephone transmission requirements; specifications for cables, apparatus and plant in a modern telephone system; protection of telephone lines against electrolytic corrosion; and many others. There are a number of technical articles from different organisations and manufacturing firms on apparatus and lines. Not the least useful part of the report is the extensive classified bibliography of articles in English, French and German spread over seventeen closely printed pages covering every aspect of telephone communications.

The reports of the plenary meetings are very interesting in showing the cordiality among the delegates and the spirit of mutual accommodation to promote the common objective of universal telephone communication.

Would that other international gatherings were as fruitful in their achievements as the meetings of the C.C.I.!

R. E.

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FIFTY YEARS OF THE SOCIETY OF PUBLIC ANALYSTS. By Bernard Dyer and C. Ainsworth Mitchell, pp. viii+278; 4 plates. (Heffer and Sons, 1932. Price 12*s*. 6*d*.)

This work is divided into two portions, the first of which deals with the foundation of the Society of Public Analysts and its subsequent history on the administrative side. The work of each president is reviewed in detail and the important part played by the Society in developing the control of foods and drugs is explained. This consisted not only in the appointment of committees to deal with the technical aspects of all the more important branches of food analysis but also in carrying on negotiations with Government in order to obtain legislative sanction for their recommendations.

The second portion is a classified abstract of the more important papers which have appeared in "The Analyst", the organ of the Society, since its inception. These are grouped in decades and while this arrangement shows very clearly the expansion of the Society's activities, it is a little inconvenient if it is desired to trace the history of any one substance. This portion of the book also suffers, as from its very nature it must, in appearing to be a complete account of the subject, whereas in fact it is restricted to the publications in only one journal.

While primarily written for those having a personal interest in the Society, this volume should appeal to many others and particularly to those in India who are endeavouring to legislate for the control of foods and drugs. Many of the technical difficulties have been solved, although by no means all, but the legal and administrative difficulties still remain and a perusal of the book will indicate how vast these are,

while at the same time pointing out pitfalls which may be avoided.

H. E. WATSON.

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SOLVENTS. By Thos. H. Durrans. Third and Revised Edition. 205 pp. (Chapman & Hall. 10*s*. 6*d*. net.)

The title of the above book belies its contents to some extent as it is solely confined to cellulose lacquer solvents. The reader who takes up the book with the idea of finding a general treatise on "Solvents" and the wide range of subjects which this word visualizes, is somewhat disappointed at the very narrow field dealt with. The title for a monograph can well be more explicit.

In all other respects the book is excellent and should prove extremely useful as a work of reference on cellulose lacquer solvents. The volume is divided into two parts. The first part deals in a broad and simple manner, with the scientific fundamentals of 'solvents' in relation to solvent action, vapour pressure, viscosity, etc. In Chapter IV the application of triangular co-ordinates for solving practical problems in the lacquer industry is dealt with in a simple and instructive manner, and a careful study of the method will be of considerable use to the reader in other branches of chemistry as well. Chapter VI includes tables of what are called 'Evaporation Periods' which are far too Empirical to bear publication.

The second part of the book is more utilitarian and deals comprehensively with individual solvents in the lacquer industry. In fact the material presented forms a regular text-book of industrial organic chemistry of the lacquer solvents. The concluding portion of the book contains a table of trade names of solvents and their probable composition, the intelligent use of which will save a good deal of time and money to any lacquer technologist.

The print and get-up of the book are excellent.

M. RAJAGOPALAN.

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MANUAL OF PLANT DISEASES. By Frederick Deforest Heald, M.S., Ph.D. Second Edition. (McGraw-Hill Book Co., Inc. New York and London. 1933.)

The rapid progress of investigations on Plant Pathology in recent years, all over the world, resulting in a considerable output of literature on this important subject, makes it a difficult task to embody all the information in the form of a manual. And yet this has been achieved by Mr. Frederick Deforest Heald in his book. Though mainly intended as a text-book for students by the author who has been a teacher in Mycology for 16 years in the State College of Washington, this book, which contains quite a wealth of information and references, should be of great value to every research worker in Plant Pathology.

The symptoms of disease in plants, with a summary, are first described in such a way that it is intelligible both to the practical grower and the Pathologist.

The tendency for investigators in general, is to look for an organism fungal, or bacterial wherever a disease is concerned. Sec. II of this book is well worth studying by all Plant Pathologists, wherein are described in detail various diseases caused by deficiencies in food materials, and excessive soluble salts in the soil, by unfavourable water relations, by improper air relations, by high and low temperatures, by unfavourable light relations, by manufacturing processes such as cement dust, tar products, SO_2, etc., and by control practices themselves.

Sec. III dealing with virus diseases of plants has been written more elaborately than in the First Edition. During the last few years which, according to the author, may be designated as the "Mosaic Period", many new virus diseases of crop plants, and the rôle of insects in transmission have been brought to light. After a detailed description of some types references are given at the end of chapter to 149 virus diseases of plants.

Sec. IV which occupies the rest of the book deals with parasitic diseases. After a clear description of the morphology of bacteria, and their action on hosts, four important types of bacterial diseases are described. An exhaustive list of references is appended.

Then follows a description of a large number of diseases caused by fungi, arranged according to the groups to which these belong, only important types being chosen. It is difficult in the course of this review to bring out in full appreciation the wealth of information which these chapters contain. The chapter on "Diseases due to Rust fungi" deserves special mention for its lucid presentation. The last two chapters deal with diseases caused by Phanerogamic parasites and nematodes.

Such a valuable book can hardly be criticised for a few omissions under

references. Though some attempt has been made to include under "References" a few of the work on Plant Pathology done in India, it is felt that other valuable work done in India could also have been included.

In Chap. XXVII, under Parasitic Plants, the valuable work of Barber on Santalum Album, deserves mention. In Chap. XVI, under Diseases due to Downy Mildews, the pioneer work of Coleman on the Arecanut disease caused by *Phytophthora arecai* (1910), of Narasimhan on the heterothallic strains (*Phytopathology*, **20**, 201, 1930) and Uppal on Scleropora, could have been included. In Chap. XXVI, the disease on Coffee (*Corticum Koleroga*), which is a serious one in S. America, Mysore and other tropical coffee growing areas might have been referred to. To the references under Virus Diseases of Plants (Chap. XII) could have been added, the work done in India by Likhite on the Cytoplasmic inclusions in Mosaic tobacco, and by Narasimhan on the inclusions associated with Spike Disease of Sandal (*Phytopathology*, **23**, 191, 1932). These omissions of Indian Phytopathological work do not in any way detract the value of the book which should be in the hands of every research worker on Plant Pathology. The get-up of the book bears usual excellence of the publications of the McGraw-Hill Co.

M. J. N.

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CYTOLOGICAL TECHNIQUE. By John R. Baker. (Publishers: Messrs. Methuen & Company, Limited, London. 3*s*. 6*d*. net.)

To a beginner in cytological technique, it is very essential that he should know what he is doing and what he is aiming at. More often irrational methods in the hands of a beginner yield very satisfactory results and the interpretation of the preparation becomes an arduous task unless he knows the principles and the chemical changes involved in the various stages through which the material passes before it is finally ready for examination under the microscope. The guiding principle of the author of this monograph has been to describe as few methods as possible and to present full information as to the nature of the reagents used.

In the routine laboratory practice the beginner is apt to use fixing and staining reagents in a haphazard way without knowing to what extent the results are due to the original components and to what extent they are due to their reactions.

In the introductory and the following chapter, the author gives a very clear exposition of the morphology of the cell and the principles and the chemical changes involved in employing the most common reagents like ethyl alcohol, acetic, picric, mercuric chloride and osmium tetroxide and enables the beginner in cytological technique to make a judicious use of these in the study of the cell.

The chapter on the fixing mixtures is a clear exposition of the nature of the reactions and particulary valuable in selecting reagents for the study of specific cell constituents. The small monograph is characterised by the care which the author has taken to make clear all matters which give difficulty to beginners.

The book is the outcome of the author's experience gained in cytological technique and records only those methods which have given the best results in his hands and is a welcome addition to books on microtechnique.

Though the study of the cell *intra vitam* is likely to be the basis of all future cytological investigation and the making of permanent preparations only an accessory to it, we have no hesitation in recommending this interesting monograph to all beginners in cytological technique as a very valuable and instructive guide to them in their endeavour to acquire proficiency in this field of scientific investigation.

A. N. R.

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JAPANESE FISHES. People interested in Fishery problems are no doubt aware that the fishing industry of Japan is probably the most highly organised in the whole world. The fisheries of Japan are exceedingly valuable; and the total value is believed to be at least £ 30,500,000 per annum, while the industry employs no less than 2,000,000 men. This remarkable result has been achieved within a comparatively short time through the application of scientific methods and the rational and economic exploitation of the fisheries.

During the last 20 years or more Dr. Tanaka has been studying the fishes of Japan mainly from a systematic point of view. Such a scientific work would not seem to some to be of any direct economic value, but it should be borne in mind that taxonomic work is the bed-rock on which almost all fishery investigations have to be based. Every country interested in its fisheries has

voluminous works on fishes, but a recent publication of Dr. Tanaka entitled "Japanese Fishes in Life Colours" is unique and a most useful handbook. It contains beautiful, coloured illustrations of over three hundred and fifty-five species, each one of which is briefly described both as regards its economic importance and systematic position. The size of the work is that of a pocket-book, so that it can be carried about very conveniently and its price has been kept low. Publications of a similar type dealing with the principal food-fishes of the various provinces of India will be a great boon to amateur naturalists and are likely to prove most useful to officers interested in the development of Indian fish resources.

Dr. Tanaka's book is written in the Japanese language, but the scientific names of the various species are given in Roman characters and there is a very good index at the end.

S. L. H.

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THE SENSES OF INSECTS. By H. Eltringham, M.A., D.SC., F.R.S. Pp. vii+126 with 25 illustrations. (Methuen's Monographs of Biological Subjects. Edited by G. R. De Beer, M.A., D.SC.) (Methuen & Co., Ltd., 36 Essex Street, W.C. London. Price 3*s*. 6*d*. net.)

To students of Entomology and General Zoology this monograph will be an invaluable possession. Within a short compass, the author, a distinguished authority on insects, presents an extremely interesting account of the different types of sensory organs of these minute creatures, which can be read and enjoyed even by those who have only modest biological learnings. The information provided in each chapter is authoritative and up-to-date and the numerous illustrations assist in obtaining a clear understanding of the technical details and structural relations of the sensory organs. The intelligence displayed by insects especially by the social orders such as ants and termites implies not only the possession of highly developed sensory organs but also actually the powers of reasoning and judgment though in a rudimentary state. The complicated structure of the various organs of special sense is a marvel of mechanism and the manner in which the various parts are articulated to fulfil the special function for which they are devised must always remain a puzzling chapter in the philosophy of biology. In spite of a few technical terms indispensable in a book of this nature, one can read it with great pleasure and profit and we have no doubt that the reading public interested in obtaining accurate scientific information will welcome such biological monographs. A complete bibliography is given which will be useful to all wishing for fuller information with a view to undertake research.

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FIGHTING THE INSECTS, THE STORY OF AN ENTOMOLOGIST. TELLING OF THE LIFE AND EXPERIENCES OF THE WRITER. By L. O. Howard, pp. xvii+333. (New York: The Macmillan & Co., 1933. Price 12*s*. 6*d*. net.)

This is a splendid book full of humour, interest and information. It deals with the practical application of scientific researches to combat the insect pests and the account is presented in an easy style and attractive form which will profit everyone who is interested in the contributions of science to the promotion of public health and the increase of public revenues. It is a record of the tireless efforts of a great man in organising an international campaign against the minor and major horrors of peace and war, with numerous autobiographical sketches of piquant interest.

Howard, a born naturalist, was originally trained for the medical profession which he abandoned to take up an assistant's post under Professor Riley who had been brought from Missouri to assume the appointment of Entomologist to the U. S. Department of Agriculture. Prof. Gage bade farewell to his old student in these words: "Now, Brother Howard, you and I are going to devote our lives to science. We are not going to let any confounded girls come between us and our work." While working in the Federal Bureau of Entomology in Washington he wrote in these words to his mother in 1884 about the share of credit which usually in those days fell to the lot of assistants: "Whenever you see a treatise by Professor or Dr. So and So in which he says in his introduction, 'I cheerfully acknowledge the help of my assistant Mr.....' or words to that effect, you can make up your mind that the Professor wrote the introduction and the assistant the treatise." As soon as Howard became head of the department in 1897, he changed the old practice and permitted the assistants to publish their work in their name,—a reform which attracted to his service some of the eminent American biologists. When Howard was working as

an assistant under Constock, he became interested in parasitic insects and the natural control by parasites and predators and the interest so early formed in the study of these little creatures and of their extraordinary interactions, has continued all his life and the first fruits of his labours were embodied in a big paper on the parasites of coccidæ. The most dramatic episode of this period was the successful introduction of "Australian Lady Bird" which completely destroyed the fluted scale that threatened the extinction of the citrus industry of California. In 1894 when Riley resigned, Howard received the appointment as Chief of the Service and his efforts to focus the attention of Europe and America on combating the grapevine Phylloxera, the Gipsy Moth and Brown-tail Moth, the Mexican Cotton Boll Weevil, the discovery of the eggs of tachina fly on the army worm, the rice stem borer and on the unintentional interchange of injurious insects between countries through commerce, constitute the noblest chapter in the history of applied entomology. His experiments to introduce silk culture in the United States may have failed, but his attempt to establish international co-operation in overcoming and eradicating insect pests through natural control laid the foundation of the industrial prosperity of America and curiously, he never suffered from want of funds from the Government for carrying on his researches and founding expensive Laboratories.

The book has a strong human appeal. It is the story of a great scientist with an amiable simplicity of character who freely wrote and practised "internationalism" and endeared himself to every scientist in Europe with whom he came in contact. His account of the Cosmos Club, the Bicycle Club, his services in the preparation of the Century Dictionary and International Encyclopædia, his scientific expeditions and his description of Congresses and personal conversations, his work on mosquitoes and domestic fly, his public lectures and scientific addresses and every other detail of the career of this remarkable scientist, will form an enduring record of noble service cheerfully rendered for the advancement of knowledge and the promotion of human happiness.

To read Howard's "Fighting the Insects" is liberal education.

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THE LIVING UNIVERSE. By Sir Francis Younghusband, pp. x+252. (London, John Murray, 1933. Price 10*s*. 6*d*. net.)

The book is rather of a mystic nature and propounds the theory conceived by philosophers of antiquity that the Universe is peopled by other kinds of life and in support of this doctrine, the latest findings of physical and biological sciences are made use of. The conception that the Universe is fundamentally material is abandoned and the possibility or probability of the existence of living beings in distant planets not recognised yet, forms the theme of the book.

Astronomy must have a great deal to say about the problem of the relation of life on this planet to the Universe of which it is a part and in conjunction with biology it will have some day to find a solution for the puzzling question of the origin of life and its ultimate destiny. Sir Francis Younghusband has gathered together the results of science and has given them the interpretation of an intuitive philosopher. The first two chapters deal with the ultimate facts of the Universe and the evolutionary process of life as stated by Jeans and Eddington, Wells and Huxley and Darwin. Mind can hardly be dissociated from life and its functions though limited by the physical framework through which both function, vary and expand in accordance with the character of the machinery and intuition is considered to be the line along which mind will develop in future. From creative love, Younghusband derives the mystical experiences of ecstatic world-love and it forms the main-spring of the Universe. Such experiences are not wholly subjective, for the mystic has a deeper sense of union with Nature and responds to the intimations which come from the world about him. The Universe is pervaded by the Cosmic Spirit which controls and directs it and the purposiveness and orderliness of it arise in a big thought of this Spirit. The realm of matter is subordinate to the governance of this Universal Mind. "I shall regard Jeans' principle of a creative intelligence as by no means tentative, but as the perfectly logical corollary of modern scientific facts." Sir Francis Younghusband makes a crucial point of this statement of Dr. Turner in regarding the Universe as an organism and argues that if our earth is part of it and has developed life and mind, then it follows that life and mind are characteristics of the Universe as a whole,—"that it was because

the Universe was a living Universe that life developed here". Then it is deduced that the Universe is not a mere machine but the outward face expression of the Cosmic Mind.

The book may not make an appeal to scientists of the type of Thomas the Doubtor, who want demonstrable evidence and those who would reduce the Universe to a mathematical formula. Scientists are becoming metaphysical and find it difficult to escape from conceding the existence of design and pattern, order and purpose in Nature under the Governance of an Agent to whom the Universe is as a venture. The book is an admirable exposition of the ancient doctrines of the Upanishads and upholds the dualistic system of philosophy. It is a valuable contribution to contemporary philosophic thought

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WHAT DARE I THINK? (A Challenge of Modern Science to Human Action and Belief.) By Julian Huxley, Professor of Zoology in the University of London (King's College). (The Phœnix Library, Chatto and Windus, London. Price 3*s*. 6*d*.)

The book contains a series of seven brilliant lectures which the author was invited to deliver at different places and at different times. We would place a copy of this stimulating work in the hands of lawyers, priests and politicians. The first three essays deal with some of the economic and social problems with which modern civilisation is confronted and the growth of human population, chiefly its quality in its bearings on social efficiency and economic salvation, offers to all thinking minds perplexing questions. In the first three essays the author in his search for a solution examines the contributions which biological investigations have recently made and untrammelled by sentiments, suggests that the practice of birth-control and eugenic sterilisation may offer hopes of solving the problem of population. Under what the author calls long range eugenics, selective breeding of human species must necessarily come in and one may doubt if man can be treated like peas and wheat for purposes of the application of Mendelian principles of selection. The next three essays deal with science and human nature and they give a vivid idea of the concept of scientific humanism. The author's interpretation of the implications and function of true religion and those of science is unexceptional, but all may not agree with him in thinking that the spirit of science is opposed to the conception of personal God, who "is imminent but not transcendent". Both religion and science are based on experience, the former is objective and latter subjective. Their conclusions must have different scales of value and the method of enquiry pursued by one is incapable of being applied to the other. But the validity of both depends on the fact of direct experience which may be introspectively analysed; the outer works of which in the case of science are verifiable evidence, but those in the case of religion must remain the fundamental fact of universal intuition which cannot be weighed and tested in the laboratories but can only be perceived in the innermost consciousness.*

The book is undoubtedly a notable contribution and is bound to exercise a great influence on contemporary international thought.

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THE MYSORE TRIBES AND CASTES. Vols. II, III and IV. By the Late H. V. Nanjundayya, M.A., M.L., C.I.E., and Rao Bahadur L. K. Ananthakrishna Iyer, B.A., L.T. (Published under the auspices of the Mysore University. 1928, 1930 and 1931. Price Rs. 12-8 or 20*s*. each volume.)

We congratulate the University of Mysore on the publication of these sumptuous volumes which undoubtedly form a signal contribution to our knowledge of the Tribes and Castes of Mysore. Rao Bahadur L. K. Ananthakrishna Iyer to whom the work was entrusted, is a well-known South Indian Anthropologist whose earlier works on the Cochin Tribes have earned for him the reputation of a sound scholar and as a lecturer in Anthropology in Calcutta University, he has had great opportunities of initiating research work in this important branch of science. The three volumes which we have read with unfeigned interest and profit, would form a noble tribute to a long and honourable life devoted to study and research. We are promised the first volume soon and we look forward to the pleasure of reading it with equal interest.

In the three volumes under review, about 92 Castes and Tribes are described and each volume is profusely illustrated with beautiful pictures of people in their typical

* The sensing of the ultimate nature of reality is one thing and the study of the laws of its manifestation in concrete expression is quite another thing.

costumes, or at their social functions or in their professional occupations in addition to pleasing photographs of famous temples and public institutions for which Mysore is well known. In his extensive field work, Mr. Iyer has collected a great amount of information regarding the historical origin of the several castes, their tradition, distribution, their habits, customs, manners, religious persuasion and practices, dress, furniture, marriage customs, divorce, ceremonies connected with child birth, inheritance, funeral ceremonies and occupations and industries and ornaments and social and economic status. Mr. Iyer from his extensive experience and knowledge is competent to draw certain generalisations based on his studies, in respect of the causes which have led to the bewildering sub-divisions of castes and the differences in their social behaviour even among groups which follow a common language and a common religion. What is the relation of these tribes to the Dravidian or the Aryan stock? Mere ethnographic work leads us nowhere, however valuable the study may be, if no attempt were made to trace the differences of social customs to some common origin and to trace the groups to a common ancestral stock. Cultural Anthropology as a descriptive science is exceedingly interesting, but we believe that this branch of knowledge is to be founded on Physical Anthropology and without measurement no science becomes exact. It is unfortunate that Mr. Iyer was unable to carry out any investigations on cranial measurements, structure of hair, form of nose, ear and eye in proportion to other anthrometrical features, relative proportions of limbs, the size and shape of feet and digits, the structure of nails, the hairiness of body and the shape and size of chin and forehead and everything about the physical organisation of the members of tribes which would disclose their original and mutual relationship. We hope that in the promised first volume of this interesting series, some reference will be found to this fundamentally important piece of work without which all ethnographical studies must be incomplete and we further hope that Mr. Iyer will stress the importance of the formation of a Museum in the State as a means of diffusion of knowledge about the people whose proximity takes away all incentive to closer study. Another point on which Mr. Iyer should have legitimately laid emphasis is the desirability of the University to introduce cultural and physical Anthropology in their scheme of studies and it will form an admirable combination with Psychology, Physiology and Zoology. With such abundance of material for study and investigation,—Mysore is a veritable Museum, and with little or no expenditure, we hope that Mr. Iyer will be able to induce the authorities to recognise the importance and need of instituting these fresh studies in the University of Mysore.

We have pleasure in acknowledging our sense of thankfulness to Mr. Iyer for providing us with genuine pleasure and interesting information which we have derived by a perusal of his volumes, and hope that others who have access to them will also derive equal profit by a perusal of these careful and painstaking studies.

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HOMER AND MYCENÆ with 52 Illustrations and four maps. By Martin P. Nilsson, Dr. Theol. et. Phil, pp. xii+278. (Methuen & Co., Ltd., 36, Essex Street, London, 1933. Price 21*s.* net.)

There are numerous important contributions to the discussion of the Homeric problem and several theories have grown round it. According to the separatist school, Homeric epics are a patch work,—and the author being merely a compiler or redactor and the materials he has utilised pre-existed in the form of short epics or lays to which he added some of his own and later ages contributing others. It is almost impossible to settle the question of the authorship of epics of the magnitude and range of the *Illiad* and the *Odyssey* and it is even doubted if Homer ever existed beyond legends and myths. The unitarian school upholds that these works are the creation of the genius of a historical person and is not troubled with the pre-existence of independent lays and heroic poems. The literary criticisms on the heroic age of Greece are bewildering and it is doubtful if finality will be reached. The English Homeric scholars treat the problem as part of the genesis of epic poetry and others starting from archæological or ethnological considerations, end in discussing their bearing on the epic problem.

Martin Nilsson proceeds to examine the question from the standpoint of the probable contributions of Mycenæn culture to the epics of the heroic age. The archæological materials belonging to this age have thrown a flood of light on the influence of

this period and on the history of Greece. Historical researches into the archæological finds, the languages together with their dialects and ethnic problems, have established that Greece was occupied by a pre-Greek population whose civilisation was a modified form of Minoan culture from Crete. This pre-Greek or Mycenæn culture is divided into three distinct periods in accordance with the traces and gaps in it produced by the successive invasions of the Minoans. At the time the Greeks immigrated, the country had witnessed and bore evidences of a strong civilisation and as always happens, the immigrants must have absorbed the greater part of this pre-existing culture to which they added their own. Homeric scholars have divided themselves into two camps, one interested in taking the epics to the Mycenæn times and the other pushing them forward as late as the historical age. Nilsson considers that neither of these views is the right one. His researches are based not only on archæological elements in the Homeric poems, but extend to geographical and historical circumstances including State organisation, customs, religion and place names. Few can deny the fact that in Homer there is considerable evidence which refers to the pre-Greek civilisation or Mycenæn age and also to the Archaic age, the Geometric and the beginning of the Orientalising periods. The Mycenæn and Orientalising elements are separated by an age covering more than half a millennium. How is it possible that the former elements could have survived such a long gap and have been adopted in a composition belonging to a time at least half a millennium later?

The language and style of Homer present similar difficulties. The former is a mixture of several dialects chiefly Ionic interspersed with extensive Aeolic, Attic and Arcado-Cypriot elements. His style is distinguished by ornate epithets, used repeatedly in conjunction with proper nouns, especially with those of his heroes, Achilles and Odysseus, and another characteristic is the extensive use of stock expressions. The language goes back into very old times and the point of interest is how these archaisms were preserved down to his day. Most of these linguistic elements are Mycenæn, which as an age of great and heroic deeds, of warriors and princes, really forms the background of Homeric epics. The Homeric poems are founded on a mass of songs of minstrels which with countless variants based on the exploits of heroes, must have wandered from country to country before attaining the perfect epic technique with which Homer composed the tales of Troy and the wanderings of Odysseus. Certainly larger or smaller parts may have been added later on to Homer's poems. Still the general conclusion can hardly be resisted, *viz.*, "Owing to the epic technique and tradition elements from the Mycenæn age, in which epics first were created, were preserved down to the age in which epics underwent a renaissance, were fixed into two great poems, the *Illiad* and the *Odyssey*, and ultimately written down." The references to Mycenæn State organisation and the Mycenæn origin of Homeric myth and the contributions of that age to poetic fiction—all bear ample evidence to this general conclusion.

We have read a great book, distinguished alike for scholarship and for historical research. It is an enduring work bound to exercise a great influence on the future investigations into this most important and puzzling problem of Homeric poems. We congratulate the publishers on their enterprise in offering to the literary world a work of such excellence and on the splendid execution of their technical labours.

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COLON CLASSIFICATION. By S. R. Ranganathan. (Madras: The Madras Library Association. London: Edward Goldston, Ltd., 1933.)

The Madras Library Association has commenced the publication of a series of books on library work of which "Colon Classification" by Mr. Ranganathan is the third. It differs considerably in various respects from the works on classification hitherto published. One of the main features which will strike even a casual reader is the very great minuteness of classification in most of the subjects treated, especially topics in Indology, which will be of immense use to librarians both in the East and in the West. The author deserves to be congratulated on his excellent performance. The book ought to find a place in every library, however small.

Errata.

Current Science, Vol. II, No. 4, October 1933, page 130, left-hand column, in the magnifications of the photographs—

for '70' *read* '56'
for '30' *read* '24'